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ABSTRACT

A basis for comparing available equipment against the requirements of the prospective user or purchaser of microform retrieval equipment is provided. As used in the handbook, microform retrieval equipment is defined as any device that is used to locate, enlarge, and display microform images or that produces enlarged hard copy from the images. Only equipment available in the United States is included. (AB)

FOREWORD

Microfilm has been used for over 40 years as a medium for the procedural recording of voluminous business records and for the protective and archival recording of rare and vital documents. In the past decade, management has recognized microfilm as a valuable tool for the duplication, distribution, storage, and reference for the growing volume of information. This growth is accelerating. As computer output microfilm (COM) continues to develop, and other micrographic technologies are linked to data processing and other techniques, more efficient information processing will result.

The purpose of this handbook is to provide the prospective user or purchaser of microform retrieval equipment a basis for comparing available equipment against his requirements. It is not an equipment catalog, nor is it an attempt to evaluate any individual manufacturer's equipment.

Although this handbook is issued as one of a series of Records Management Handbooks produced by the National Archives and Records Service, General Services Administration (GSA), the United States Air Force shared in its development. It was produced under a contract jointly funded and administered by the Air Force and GSA.

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I. MICROFORMS, FORMATS, AND GENERAL CONSIDERATIONS

As used in this handbook, microform retrieval equipment is defined as any device that is used to locate, enlarge, and display microform images or that produces enlarged hard copy from the images. Only equipment widely available in the United States has been included; however, inclusion of equipment now on the market has necessarily been limited to those items for which information was received prior to the publication date.

This first chapter provides information about the most widely and generally used microforms and describes considerations related to equipment requirements. In chapter II, those factors are discussed that affect equipment selection regardless of the type of microform. The next four chapters further describe the equipment available for reference to a given microform. Operational and functional information about the equipment available is compiled in tables in each chapter.

Chapter VII briefly describes equipment that does not readily fit the classifications used in chapters III through VI but provides types and levels of retrieval and reference that will be of interest to many.

The appendix lists the manufacturers who supplied the information about the equipment included in the handbook.

Equipment Classifications

The microforms most widely used in the United States are:

- Conventional roll film, 16-mm. and 35-mm., stored and handled on standard reels.
- Roll film stored in magazines or cartridges to facilitate handling and retrieval.
- Multiple-image formats: microfiche, jackets, and jacket punched card hybrids.
- Aperture cards.

Each of the above microforms is described later in this chapter. A considerable number of retrieval devices, readers, and reader printers are available for each type. They offer a broad range of functional features. Accordingly, a chapter is devoted to equipment designed primarily for each of these classifications of microform. To the user's advantage, much of the equipment will handle one or more of these classes of microform. While this makes classification of microform retrieval equipment a little difficult, the prospective user should realize that there are few, if any, truly "universal" reference devices. In this handbook, equipment is listed under the microform for which the unit is primarily designed, and the availability of adaptors or ability to accept other microforms is shown. In a few cases, different models, as identified by the manufacturer, of a basic unit are listed in two sections.

Films

The films used to microphotograph documents have the same basic chemistry and appearance as the black and white silver emulsion films that are used in hand-held candid cameras. There the similarity ends. Microfilm emulsions are much finer grained, thus slower, so that they can record fine detail with a high degree of sharpness or acuity. So that more of the film area is available for the image, microfilm has no perforations along the film edges. Accordingly, microfilm cameras, readers, and other equipment do not use sprocket wheels to transport the film.

Camera microfilm is supplied in 16-, 35-, and 105-mm. widths under well-established

specifications. Depending on the camera used, film is supplied on 100- or 200-foot reels with solid flanges to protect the film from undue exposure during camera loading and other handling. Film is also available in other lengths and in magazines or cartridges for use in COM (Computer Output Microfilm) units and other cameras designed around a cartridge concept. Depending on the application and the microfilm system, 16-mm. film is used in both rotary or flow cameras and in planetary or flatbed cameras. In most systems 35-mm. film is used for precision microrecording in planetary cameras. Cameras designed for the step and repeat filming of images in a microfiche format, several COM units, and some engineering drawing cameras use 105-mm. film.

Exposure of the film and processing of the exposed film are conducted under carefully controlled conditions to produce an optimum result in the master film. Some cameras are designed to expose two rolls of film simultaneously; one becomes an archival record, and the other a working master in the system.

The importance of microfilm in information systems derives from the fact that microfilm is self-reproducible, and under well-established and carefully controlled conditions, film-to-film copies of very high quality and fidelity can be made from the master microimages. Again, depending on the total system, the master film can be duplicated on a roll-to-roll basis to produce duplicate rolls for distribution on reels or in cartridges or magazines. In other systems, the master film may be unitized by mounting frames in aperture cards, placing strips of related images in jackets, or laying up strips cut from the master roll to form a microfiche master. These unit microforms can then be duplicated as such.

Equipment is available and the duplicating films used are packaged to match the requirements for information systems based on all the widely used microforms. In the duplication of the master microimages, three different types of film are used:

1. *Silver copy films*, like camera films, are sensitive to visible light, but the emulsions are balanced for optimum film-to-film copying. Most of the silver copy films reverse the image mode when processed, producing a positive copy from a negative master or a negative copy from a positive master. A direct duplicating film is available that produces negative from negative or positive from positive images.
2. *Diazo films* are sensitive to ultraviolet (U.V.) and near U.V. energy and can be handled in yellow or subdued light. The exposed copy film is developed either by placing the film under pressure of ammonia briefly or passing it through a chamber of warm ammonia vapor. Diazo films do not reverse the image mode and copy negative images as negative and positive images as positive. Recently a reversing diazo film has been introduced for use as a reproduction intermediate.
3. *Vesicular films* (most commonly known by the trade name, Kalvar) are also primarily U.V. sensitive and are developed thermally. Most vesicular films reverse the image mode, but nonreversing formulations are available.

While the recipient of microforms and the user of the retrieval equipment for whom this handbook is written will not normally be concerned with film duplication and types, it is important that they realize the versatility of the technology which might be used in the system.

Formats and Standards

Formats and standards used in producing microforms have been developed from several sources. Microfilm standards have been issued by:

ANSI	American National Standards Institute (formerly ASA and USASI). These microfilm standards generally carry designations such as PH5.1-1959.
DOD	Department of Defense (e.g., MIL-M-9868).

COMMON 35mm. ROLL MICROFILM FORMATS

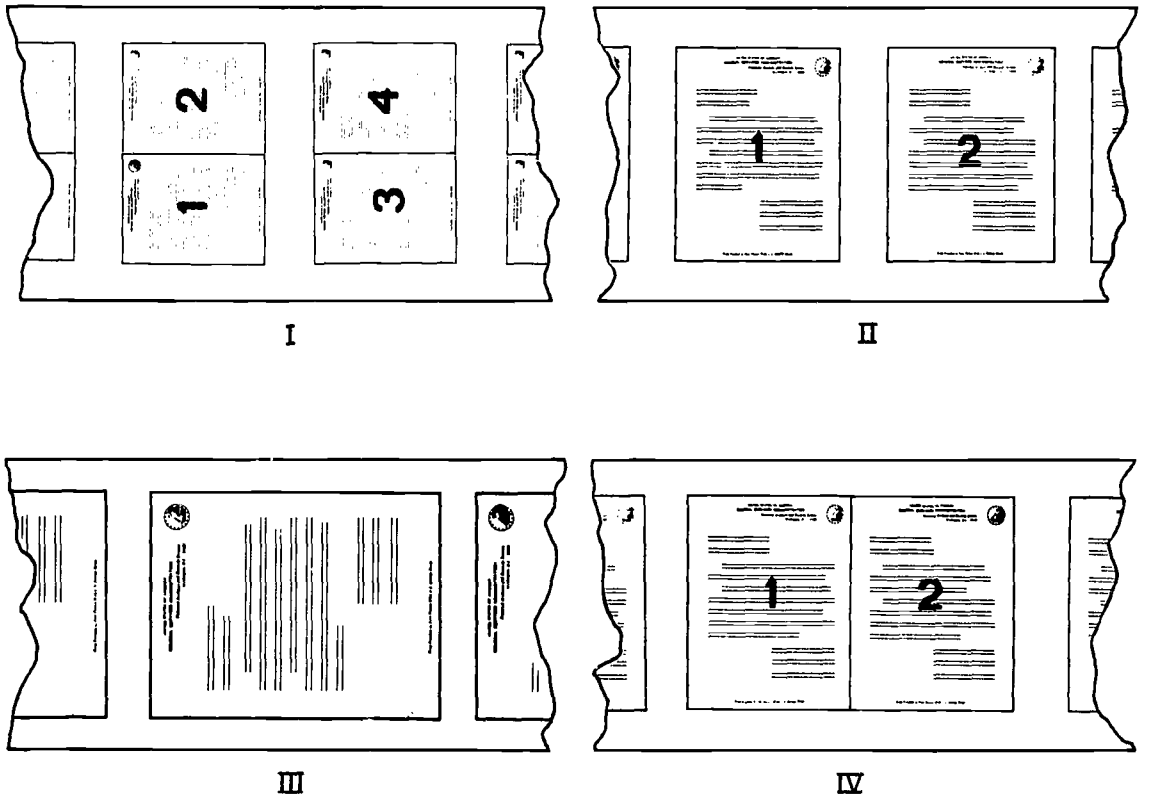


Figure 1

NMA	National Microfilm Association (e.g., M-1-1967).
COSATI	Committee on Scientific and Technical Information, Office of Science and Technology, Executive Office of the President.
ALA	American Library Association.

These standards are widely used. Nevertheless they do not define all the requirements for microfilm systems, and in many cases the volunteer standards committees are hard pressed to keep pace with the rapidly expanding technology. Many formats and practices in the field are the result of new systems demands, new hardware capabilities, and similar circumstances.

Where more than one format or film type is being used, the purchaser should try to select hardware that will meet the principle demands of his system on a priority basis. Ideally he would find hardware capable of accepting all of the microform types and formats in his system. He should realize, however, that the more universal the hardware the less likely it is to perform any one film format-handling function as well as the reader or reader printer designed for a specific microform. The final evaluation of any microform retrieval equipment should include a test of the actual microforms which will be used in the system.

35-mm. Formats. Archivists and librarians have been using 35-mm. roll microfilm for many years to preserve and distribute important historical documents, books, magazines, and newspapers. The reduction most frequently used is 14 to 1 or 14X. Some oversize items, such as newspapers, are more often

filmed at 16X to 20X reductions. The user of 35-mm. roll microfilm may encounter four different image formats, as shown in figure 1.

Formats II or IV are the most common for letter-size documents and smaller, and III and IV for newspapers. To accommodate all of these formats, a reader or reader printer should have some means of rotating the image 90 degrees to appear right reading on the screen—normal position for reading from top to bottom.

Microfiche and Film Jackets. The NMA "Glossary of Terms for Microphotography and Reproduction Made from Microimages" defines microfiche as follows: "A sheet of microfilm containing multiple microimages in a grid pattern. It usually contains a title which can be read without magnification." A film jacket is defined as "a transparent plastic carrier with a single or multiple sleeve or pocket made to hold microfilm in flat strips." A duplicate film-to-film copy reproduced from a microfiche master, or a microfiche copy, or a film jacket, may also be called a microfiche. A microfiche format is shown in figure 2.

When a document requires more than one microfiche, the second, third, and subsequent microfiche in the set are called trailer microfiche. In some systems microimages are recorded in the title area of the trailer microfiche. When this is done the eye-readable document number is usually found in the first or second frame of the trailer microfiche.

Any current standard microfiche reader will also accept a microfilm jacket of the same physical size and general format. In the newer thin-film jackets the additional layer of clear

DOD MICROFICHE FORMAT

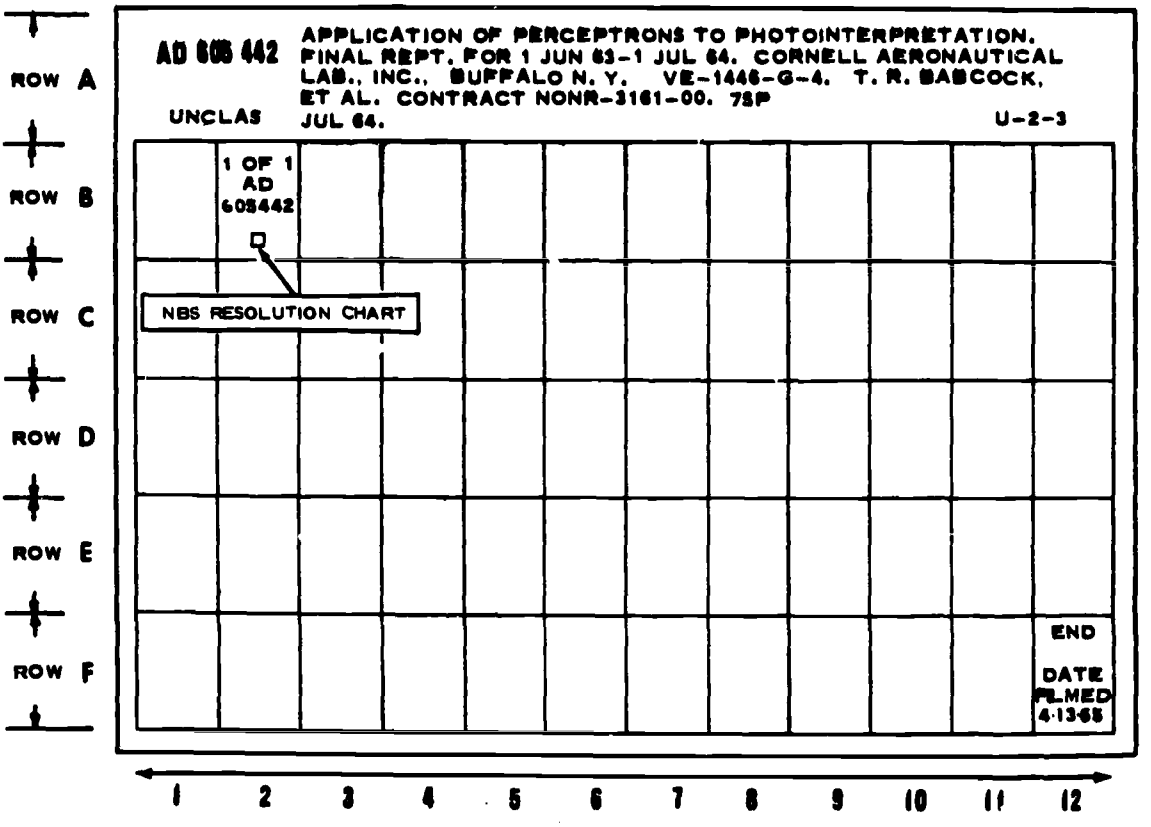


Figure 2

plastic on each side of the film in the jacket does not affect either the readability of the film or the ability to produce paper copy.

Two standards for microfiche are commonly used in the United States today. These are the COSATI Standard, widely used by the Federal Government for the distribution of report literature; and the NMA, M-1-1967. The NMA Standard encompasses two basic internal formats: one similar to the COSATI and the other at a higher reduction ratio. The NMA Standard also provides for three overall sizes of microfiche: 3- x 5-inch, 3.24- x 7.375-inch, and 105-mm. x 148.75-mm., as does the COSATI Standard. It is anticipated that similar ANSI standards will be published soon. The Department of Defense also has a specification, MIL-M-38748, similar to the COSATI. From the viewpoint of the user, the important standards criteria are:

COSATI

Microfiche size:	105-mm. x 148.75-mm. (4" x 6").
Reduction ratio:	18X to 20X.
Image grid:	
First sheet:	60 frames, 5 rows of 12.
Trailer sheet:	72 frames, 6 rows of 12.
Grid index and page sequence:	Row index begins at upper left and runs down; column begins at upper left and runs across. Page sequence from left to right.
Image mode:	Clear lines on black background (some microfiche with black lines on clear background are being distributed on an experimental basis).
Image positioning:	Rotating not required for right reading.

NMA

Microfiche Size	*Reduction*	*Image Grid*
75- x 125-mm. (3" x 5")	20X	40 frames 4 rows of 10
	24X	60 frames 5 rows of 12
105- x 148.75-mm. (4" x 6")	20X	60 frames 5 rows of 12
	24X	98 frames 7 rows of 14
3.25" x 7.375" (EAM card size)	20X	60 frames 4 rows of 15
	24X	90 frames 5 rows of 18

Grid index and page sequence:	Row index begins at upper left and runs down; column begins at upper left and runs across. Page sequence from left to right.
Image mode:	Optional: clear lines on black background or black lines on clear background.
Image positioning:	Optional: rotating suggested for right reading.

ANSI (Proposed)

Essentially the same as the NMA standards except:

Grid index and page sequence:	Recommended row index begins in lower left corner and runs up; column index begins in lower left corner and runs across. Optional: row index begins in upper left corner and runs down; column begins in upper left corner and runs across.

In addition to those covered by the published standards, many other formats have been used, particularly in industry and various micropublishing ventures. Microfiche sheet sizes range from the nominal 3- x 5-inch to 6- x 9-inch sizes, and occasionally larger. However, the majority of microfiche used today in Government and industry are of the 105- x 148.75-mm. (4- x 6-inch) size.

Reduction ratios on microfiche range from 15X to 40X. The majority of the microfiche distributed by Federal Government agencies are at 18X to 20X. Several micropublishers also use this reduction ratio to insure that their publications will be compatible with Federal report literature. In industry, the 24X standard is widely used for catalogs and similar material.

COM units generate both roll film and microfiche. Depending on the unit, the microfiche reduction ratio can vary from 20X to 48X (equivalent reduction ratios since there is no original hardcopy document for comparison). In addition to the reduction ratio, the most important factor on reader selection for COM or other computer-generated data is that many of the images have 132 characters per line and 64 lines. This equates to a standard 14- x 11-inch (w x h) page. A reader or reader printer screen should be this size or larger to accommodate such information at an equivalent to original size.

16-mm. Formats. Film 16-mm. wide is used for business records, catalogs, and letter-size documents. The film may vary in thickness, however, and therefore a standard reel will accommodate from 100 feet of standard base film (5 mils thick) to over 200 feet of thin base film. Depending on the reduction ratio used, 100 feet of film may contain the images of 2,000-3,000 letter-size documents; 200 feet, 4,000-6,000 pages.

From the equipment purchaser's viewpoint, there are three areas of formats and standards that are important:

1. Film container

Microfilm 16-mm. wide is distributed on a plastic reel or in a special container called a cartridge, magazine, or cassette. A no-rewind cartridge or cassette has two spools acting alternately as supply and take-up spools depending on the direction the film is transported. The film never leaves this type of cartridge. The rewind type of cartridge or magazine dispenses the film into the reader or reader printer for viewing. The film must then be rewound before removing the cartridge from the reader.

The cartridge serves two purposes: to protect the film when not in use and as a component of the film transport mechanism for automated film handling. Manufacturers produce at least six different cartridge systems. Many of the readers and reader printers, particularly the more sophisticated and highly automated units, will accept only one type of cartridge. A few manufacturers offer adaptors which allow the use of more than one type cartridge in the machine. No commercially available reader or reader printer accepts both standard reels and all cartridge types. The purchaser of readers or reader printers should carefully explore the matter of reel and cartridge compatibility before ordering equipment.

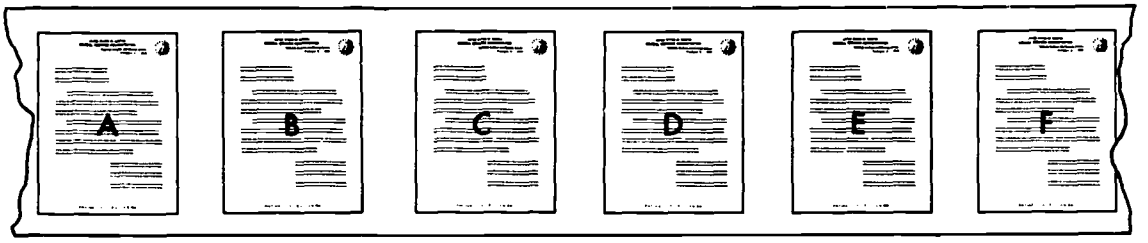
2. Image orientation and film sequence

The microfilm images can be oriented in several ways, as shown in figure 3. These are:

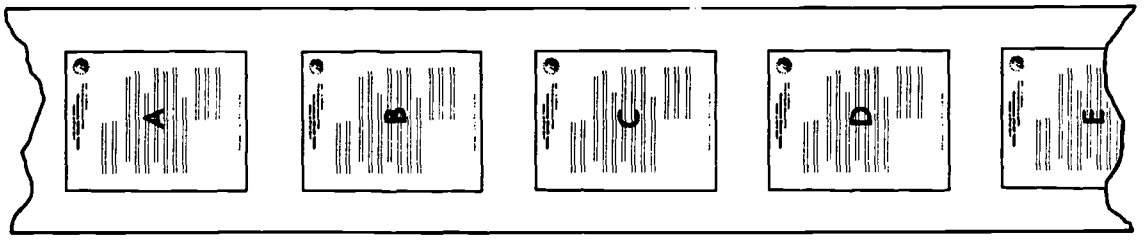
- *Simplex* with pages filmed in sequence using full film width. Page orientation can be "Comic," with pages right reading from edge to edge of the film, or "Cine," with pages right reading along the length of the film.
- *Duo,* with pages filmed in sequence using one-half the film width, reversing at end of roll to continue filming on the remaining half.
- *Duplex,* with front (F) and back (B) of documents filmed side by side.

Most 16-mm. readers and reader printers are designed to accept film with images

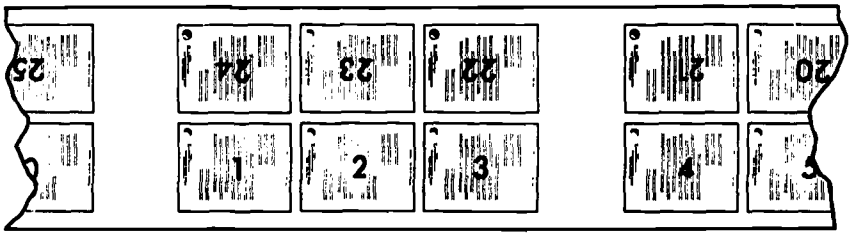
IMAGE FORMATS ON 16mm. ROLL MICROFILM



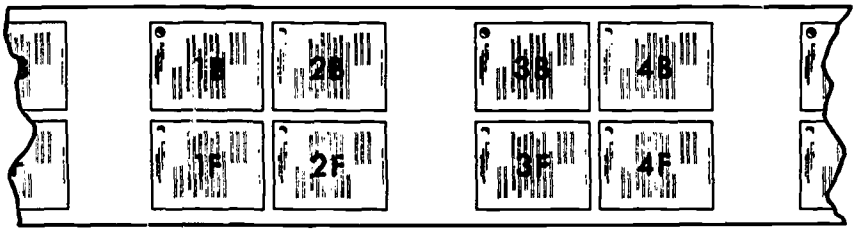
Simplex – Comic



Simplex – Cine



Duo



Duplex

Figure 3

in a comic orientation. To accept cine-oriented images and display a right reading image, the equipment should have a means of rotating the image.

Most 16-mm. simplex images have been reduced 20 to 28 times. Duo or duplex images are often reduced 35 to 45 times. Readers and reader printers should magnify these images accordingly for legible reading.

3. Film indexing

The microfilm often has code marks or index marks on the film to assist in retrieval and locating images. Some of the more common roll film index methods, shown in figure 4, are:

- Flash card or flash target: a distinctive image used to separate file segments or sets of pages.
- Film pull-down: a linear or sequential location of frames, closely related to an odometer on the machine which measures film length transported.
- Image count: marks (blips) below the frames are counted electronically and used by the machine to control image retrieval in a linear sequence.
- Bar or code line: bars or lines between the frames have positional value as related to a scale along the edge of the reader or reader printer screen.
- Photo-optical binary code: document numbers or index terms are recorded in optical binary code before each document; used with electronic logic systems for retrieval.

In each of these image finding systems, the microimage can be enlarged and read on any reader or reader printer of the proper magnification whether or not the coding or indexing system is utilized. However, for more efficient retrieval of film coded to a given page or groups of pages, the readers and reader printers need to be equipped to "read" the code method used. Accordingly, the user will need to consider the coding or index method which will be used before making an equipment selection.

Aperture Cards. Aperture cards are punched (tabulating) cards with windows containing microfilm frames. Although there are several formats, including cards with multiple apertures and cards containing jacket-like envelopes over multiple apertures, the one most commonly used is the so-called MIL-D aperture card. This card has an aperture 2 x 1⅜ inches specifically located in one end of the card as a carrier for a frame of 35-mm. film. These cards are widely used for engineering drawings and design support documents. The remainder of the card is normally used to record the document identity in keypunch code which is interpreted (printed) at the top of the card.

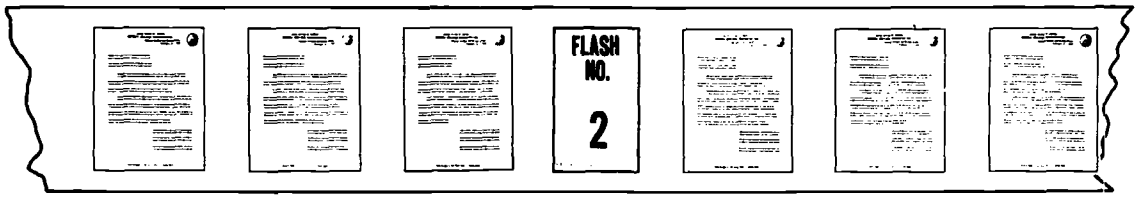
Within the mounted film frame, two formats are most commonly used as follows:

1. The entire frame is used for one document sheet or page, typically an engineering drawing. Drawings from 8½ x 11 to 34 x 44 inches are reduced to the standard frame using reductions of 16X, 24X, and 30X. Many readers and reader printers used with this format have 18- x 24-inch screens for viewing the entire aperture at a nominal 15X magnification.
2. The standard frame is used to record up to eight lettersize documents; typically these would be design support documents or technical reports. Using reductions of 20X to 24X, a 2 x 4 image grid is recorded on the frame. Cards bearing these multiple image frames can be viewed on either engineering aperture card readers or on many of the readers designed for microfiche.

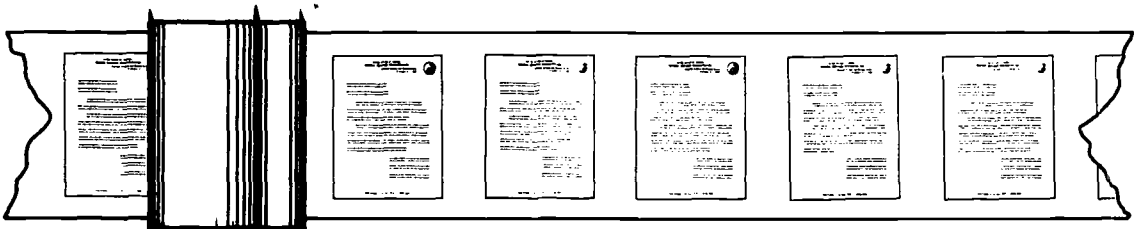
Type and Characteristics of Reader Printer Paper Copy

Several processes are used by the manufacturers of reader printers to produce enlarged

INDEX METHODS USED ON 16mm. FILM



Flash Card



Film Pull-down

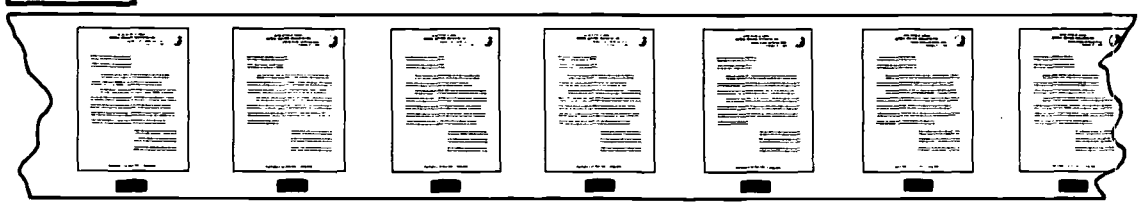
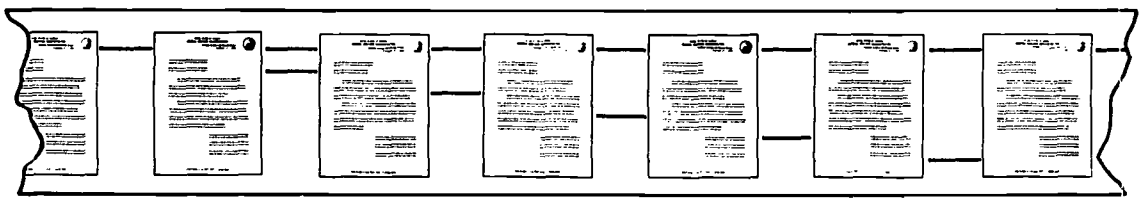


Image Count



Bar or Code Line

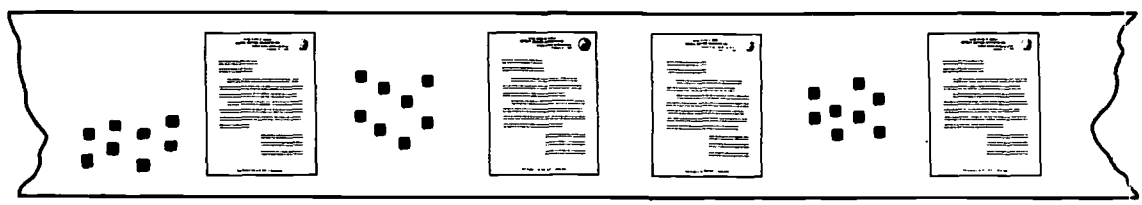


Photo-optical Code

Figure 4

paper copies of microimages. Many of them are familiar to the user, since they are also used in standard office copiers. While each of the processes produces a useful information print, they vary considerably as to cost, characteristics, and printing time. In evaluating the paper copy process, the purchaser should consider the following factors:

- Cost of supplies.
- Quality and feel of the print.
- Warm up time.
- Print cycle time.
- Convenience in operation.
- Convenience of routine maintenance.
- Shelf life of paper before exposure.
- Print life and image deterioration after exposure.

Some of these factors are obviously subjective, and the best way to evaluate the equipment is to operate each reader printer personally.

Image Mode. The user will encounter microfilm images in a negative mode, clear image, black background; and a positive mode, black image, clear background. The tones of negative images must be reversed in the hard copy process to produce black on white enlarged prints. Several of the processes used in reader printers do this; they are:

Silver halide papers, using either monobath or stabilization immersion processing.

3M Co.'s Filmac process, in which an image is deposited by surface treatment of the paper with a liquid activator.

The Itek "R S" process in which an image is formed when the exposed paper is surface treated with a liquid carrying the image forming chemicals.

3M Co.'s dry silver paper in which the image is thermally developed.

The above processes all reverse the image, producing a positive print from negative images or a negative print from positive microfilm images.

One process which has been used in a few enlarger printers, the diazo process, is nonreversing and will produce only positive prints from positive images (or negative prints from negative).

Another group of paper copy processes will produce black on white enlarged prints from either negative or positive mode microfilm images, but it is necessary to change the toner and make other adjustments in the machine before switching from one to another. If the need for changeover capability exists, the entire procedure should be explored before any purchase is made. The processes requiring changeover procedures are:

The transfer electrostatic or Xerographic process.

The direct electrostatic processes using coated papers and either dry or liquid toning systems.

Another process, the "OPC" electrostatic process, has the capability of changing from mode to mode by means of a switch on the reader printer.

The user should judge for himself how much flexibility he needs in the printing process.

With the exception of the transfer electrostatic process, which uses plain paper, all papers used in these processes are coated papers. The cost of supplies will vary with the manufacturer, usage volume, and the process. The cost of supplies is only one cost factor in finished print cost. The purchaser will also want to consider machine burden which is the cost per month to own or rent a machine, plus the cost for direct and preventive maintenance. Print cost is the sum of supplies cost per print, plus the machine burden, divided by the anticipated use in prints per month.

Reader printers and enlarger printers use either cut sheets or rolls of paper. Paper sup-

plies are usually packaged in the proper sizes for use in each type of equipment.

Each of the processes is capable of producing good prints from line work (text, drawings, etc.). Some are capable of reproducing acceptable prints of halftones and photo images as well. The enlarged paper copy can be of no better quality than the image on the film. Before it is purchased a reader printer should be tested by making copies from several microfilm samples of a quality and format typical of your system, including a few of the worst samples.

If it is planned to store and use prints for long periods of time, long-term print stability will be a critical factor. Coated papers will vary in their archival quality although manufacturers are constantly endeavoring to upgrade this and other paper qualities. If archival quality is an important consideration, ask to see prints that are 6 months to a year old and for information about the life expectancy of prints under conditions of storage and use.

Thus, the user will wish to consider a combination of factors — cost of supplies and other factors as well — in the light of his requirements when choosing reader printer equipment.

Guidelines on Equipment Requirements

No amount of effort will make equipment selection, either by type or by model, a "yes or no" decision. Based on his needs, his work methods, the microforms available to him, their informational content, and the nature of his reference to the information in the microimages, the user is his own "fine screen" of selection. For example, a clerk may comfortably use a microform reader all day to retrieve information about the status of an inventory or a series of accounts — each retrieval being a lookup of an average of perhaps a hundred characters of information. On the other hand, a user who must annotate document pages will usually be best served by having hard copies of pertinent information.

Nor is it possible in all cases to totally define the requirements of groups of users. Even in the engineering field, where microfilm has been used for 15 years for the interactive distribution of design documents, reference requirements range across the board. Some engineers' requirements are fully satisfied by reference to copy cards in desk top readers, while others require a print most of the time.

Accordingly, for the individual user the prime factor in equipment selection will be the kind of information contained in the microform collection and how it is used in his work. Then, guided by the information in this handbook, the economic situation, the need for a reader versus a reader printer, and, lastly, "hands-on" experience with that equipment which best meets his needs, one can make a proper decision.

Similarly, the individual responsible for the purchase of equipment for a number of users must have a knowledge of overall factors, including the following:

Whether the microform collection will contain one or several different microforms.

Whether the users will require readers only, or reader printers, or a high proportion of one to the other.

Whether the information in the collection will be made available through loans of the microform or by furnishing microform copies, thus indicating a possible need for portable reference equipment which the user may borrow.

One of the most persistent problems in the implementation of microfilm information systems has been determining the true needs of the ultimate user that the system will serve. Only when this has been done can the proper choice in equipment be made, using this handbook as a guide.

II. GENERAL FACTORS IN EQUIPMENT SELECTION

Many of the functional and operational considerations which affect equipment selection pertain to all readers and reader printers regardless of the type of microform. These factors are considered in this chapter, and the appropriate information for individual equipment is entered in the tables in chapters III and IV.

Price

Government prices for products are often established by bid and negotiation through the General Services Administration as well as individual agencies. Where applicable, prices shown are established Federal Government prices for hardware purchases, hardware rental, supplies, and maintenance. Commercial prices are shown where a Federal Government price has not been established. The purchaser should be mindful that while price may be important as far as total system costs are concerned, it is not necessarily a criterion for judging the quality or usefulness of a product. Through proper analysis and testing in the use environment, it may be found that the lower cost item will satisfy all requirements. Conversely, a higher-priced, more flexible unit may save time or be more satisfactory for other reasons.

Electrical Systems

Power. The standard current in the United States is 115-volt 60-cycle. All U.S.-made readers and reader printers operate on this current. In many European and South American countries, 220-volt 50-cycle current is standard. Some manufacturers have models available which can easily be adapted to foreign and other special power service. Several portable readers can be battery operated or adapted to automotive or aircraft electrical systems.

Lamps. Standard projection bulbs are used in many reference units. Many manufacturers now use more expensive, specially designed lamps which maintain approximately the same light output during the life of the lamp. Bulb or lamp failure is the most frequent maintenance item in readers and reader printers. It is well to keep a spare on hand. The life of a lamp depends on both the lamp type and the electrical system in the unit. To determine the number of lamps needed per year, estimate the number of hours each reader will be in use during the year and divide by the rated lamp life. It is generally good practice to allow the lamp to cool before moving portable readers. Projection lamps run hot, and a burned out lamp should be allowed to cool before attempting to replace it.

Cooling. Because projection lamps generate both light and heat, the projection system and film plane must be cooled to protect the film. Larger readers usually have a motor-driven blower to do this. The design of smaller units is such that convection cooling is often sufficient. The film is also protected by heat-absorbing glass elements in the projection condenser system. Regardless of the cooling system, no external part of the reader normally touched by the user with the exception of hot air vents, should be more than warm to the touch.

Screen

In most microdocument systems it is desirable to have the reader screen present an entire page of information at or near the original size. Half page or partial page images on a screen can be useful and are acceptable with some types of document systems, such as newspapers and engineering drawings. However, in making a decision about a reader or reader printer, the purchaser should be aware

of the following facts regarding reduction, enlargement, original document size, and reader screen size:

1. The original sheet sizes of common documents in inches are:

Federal Government letters	8 W x 10½ H
Federal Government legal documents	8 W x 13 H
Commercial letters	8½ W x 11 H
Commercial legal documents	8½ W x 14 H
Computer printout, two sizes	14 W x 11 H 8½ W x 11 H
International (ISO), A-4 size	210 x 297 mm. (8¼ W x 11¾ H)
Engineering drawings A size	8½ W x 11 H 11 W x 8½ H
B size	17 W x 11 H
C size	22 W x 17 H
D size	34 W x 22 H
E size	44 W x 34 H

2. The reader screen must be equal in size to the original document if it is necessary to present the entire document page at the original size. However, most documents have unused margins, and a screen slightly smaller than the original document may adequately display the information area of a document page at original size.

3. A smaller screen will also display a full page of text when the reader enlarges the image to less than original size. For example, an 8½- x 11-inch document, originally reduced 24X, can be accommodated on a 7¼- x 9½-inch screen when enlarged 20X. The characters in the text and illustrations will be proportionately smaller also.

4. A letter-size image that must be rotated 90 degrees to be right reading will require a screen 11 inches wide as well as some form of image rotation. Such images often contain tabulated data and charts or graphs.

Color. Screens can be of a neutral color, when lighted, or have a slight tint. The tinted screens are used by some manufacturers to reduce potential eye strain. Images photographed in color will show better color fidelity when projected on a neutral screen.

Type. Most readers and reader printers project images from the rear onto a translucent screen. These screens often have a matte surface on one side and a shiny surface on the other. The matte surface facing out will reduce glare and ambient reflections. The shiny surface facing out will give an apparent increase in image sharpness. A reflecting screen is an opaque one on which the images are projected for viewing.

Physical Features

Readers and reader printers are available in a variety of forms to suit the environment in which they will be used, the user's need, the system, and the cost. The basic forms are:

1. *Lap readers.* Designed for portability and personal use, they are available at present only as microfiche readers.

2. *Portable readers.* These are readers which either fold into a case similar to a portable typewriter case or are compact and portable. They are available for 16-mm. film, aperture cards, and microfiche, and are generally used on an intermittent basis.

3. *Desk readers and reader printers.* These are usually intended for more continuous use and are placed on a desk, table, or stand.

4. *Free-standing units.* These self-contained readers and reader printers have integral bases and are designed to stand alone.

Many manufacturers offer a list of accessories as well, such as floor stands, combination stands and microform storage units, adaptors for other types of microfilm, and other capabilities. The number of operating features, controls, and accessories on any unit is directly related to its cost. As a minimum, nearly every reader has an on-off switch and a control for focusing. And all reader printers have some means for controlling print time.

Human Factors Interface

A reader or reader printer should be comfortable to use. The controls should be located where they are easily accessible while the user is in the normal viewing position. The film loading operation should be simple and readily understandable after the first explanation and demonstration. The control of the film movement should be smooth, allowing for rapid movement to specific document areas and for fine adjustments to center pages on the screen. The unit should stay in focus moving from one page to the next. Any large-scale film movement should necessitate no more than a minimal focus adjustment. When indexing systems are part of the unit, they should be simple to comprehend and use. Human factors are largely subjective. They can be evaluated only by testing the equipment under actual operating conditions.

Optical Systems

Manufacturers specify readers and reader printers by image magnification (24X means the image is magnified 24 times). Most units have fixed magnifications that cannot easily be changed in the field, even though the purchaser may select one from a choice of magnifications at the time of ordering. Nevertheless, the purchaser will find many units available with magnifications changeable in the field. These are generally one of three types: units with lens systems that are interchangeable by removing one lens from the holder and dropping in another; dual magnification units, with magnification changed by means of a lever or mechanism; or systems that provide continuously variable magnification over a specified range using zoom lenses or mechanically varied optical paths. Variation in magnification is important to the user who will receive microforms from more than one source at very different image reductions. In this case, interchangeable lenses or continuously variable magnification can be considered. For the user who will need reference to images of documents over a broad size range, such as newspapers and smaller publications, continuously variable systems or dual magnification units should be considered.

Image Rotation. When the microforms used contain images which are not right reading in the normal orientation of the microform in the reader, some type of image rotation is needed. In the tables in chapters III-VI, the following notations are used:

1. *None.* The user must turn his head to view the screen image when it is not right reading or, in the case of microfiche and aperture cards, the microform must be removed from the machine, turned 90 degrees, and reinserted. One 16-mm. roll film reader can be used upright or turned on its side for reading.
2. *Optical rotation.* Images are rotated by a lever or knob that rotates a prism in the optical system.
3. *Mechanical rotation.* Rotation is accomplished by turning the film transport 90 degrees.

When image rotation is a factor, either of the last two methods can be quite satisfactory in a given case. The choice is mainly one of user preference.

Maintenance

In general, the quality of the image displayed or the paper copy provided is directly related to the cleanliness of the optical system and the

printing mechanism. Microfilm's worst enemy is dust. Dust on reader screens, mirrors, and other optical elements decreases light and illumination levels, sometimes significantly. Dust particles on the film or film holding mechanism damage the film and, when enlarged 20 to 40 times, may look like confetti on the screen and impair readability.

Preventive maintenance will make a considerable difference in the long-term usability of the equipment. Use of a dust cover when the equipment is not in use is recommended. Following the manufacturer's recommendations, cleaning of the screen, lens, internal mirrors, and condenser elements should be done on a routine basis. As noted earlier, lamps should be replaced as burned out or when the lamp envelope has darkened, decreasing light output. (Take care not to touch the old lamp when it is still hot.) A spare lamp should be available. Most units provide easy access to the lamp. Some have a clip inside for storage of an extra lamp.

Glass flats or optical flats of plastic are often used to hold the film flat in the optical system. They should be easily removed for cleaning or should be easily accessible and cleaned in place. On reader printers, loading of the paper and imaging chemicals and removal or cleaning of the printing mechanism should be easy and convenient.

Major maintenance problems should, of course, be referred to qualified maintenance personnel.

Warranties and Service

Manufacturers' warranties and maintenance service vary considerably. Most will warrant their hardware against defective parts for periods of time ranging from 30 days to 1 year. The warranty does not normally include lamps. Some manufacturers include labor costs during the warranty period, and some do not. Some manufacturers have service contracts available after the initial warranty period. Rental equipment frequently includes maintenance service by the supplier. Some smaller manufacturers may request the return of the hardware to the factory for service if they do not have locally available service engineers.

In general, the simpler the device the less the purchaser need be concerned with length of warranty or availability of local service. Once the simplest microfiche reader has been received and installed in good repair, there is little to go wrong. If defective parts are discovered, replacements can often be obtained from the factory and installed by the user. Conversely, for reader printers and the more mechanized readers, length of warranty and the availability locally of trained service personnel and service contracts should be discussed prior to equipment selection or purchase.

III. CONVENTIONAL ROLL MICROFILM READERS AND READER PRINTERS

The two most commonly used roll microfilms are 16-mm. and 35-mm. A typical reel contains up to 100 feet of standard base film or 200 feet of the new thin films. Roll film on reels can be used in some readers and reader printers having motorized drives, but most commonly rolls are used in machines that are manually operated. Accordingly, this chapter covers only units which are not motorized. Roll film stored and handled on conventional reels normally has only minimal indexing aids, such as flash cards or sequential frame numbers. In this category are:

1. Universal Readers which accept both 16-mm. and 35-mm. roll film. Many of these units can also be adapted to accept microfiche and film jackets as well.
2. Readers for 16-mm. roll microfilm.

In addition, this chapter covers reader printers which will accept 35-mm. or 16-mm. roll microfilm or both.

Physical and Operational Characteristics

A conventional roll microfilm reader normally is a simple device consisting of:

- A hand-cranked film transport mechanism.
- An optical projection and enlarging system.
- Controls: on-off, focus.
- Translucent screen. (One widely used reader projects the image on an opaque reflecting screen.)
- Housing.

In addition, the reader printers have:

- Paper transport and printing mechanism.
- Special printing controls.

The user normally performs the following functions in order to display an image on a reader:

Turn switch on.

Place reel on reader, thread film through film gate, and attach to take up reel.

Focus.

Wind to desired image.

To produce a print on a reader printer:

Set print timer to proper exposure.

Press print button.

Very little maintenance is needed for these units. The reader should be dusted at least once a week. The most critical parts are the film transport mechanism and the film gate. Glass flats at the film gate should be cleaned with glass cleaner. Manufacturer's instructions for cleaning and maintenance of the printing mechanism of reader printers should be followed carefully.

Special Factors in Equipment Selection

Conventional roll microfilm readers or reader printers employing either 16-mm. or 35-mm. film are typically used for newspapers, books, periodicals and other library reference ma-

terials. 16-mm. units are generally used for correspondence files, personnel files, security storage files, and business records for which there is a lower incidence of reference.

Film Transport. Roll film is manually transported in one of two ways on units of tnis equipment class. In the simplest case, identified in the equipment tables as "reel crank," a hand crank is attached to the spindles on which the film reels are mounted. In many units, film is driven forward or reversed through a mechanical linkage from the film spindles to a reversible crank. Though more costly, this method is more convenient.

A few of the units in this category can be adapted to or accept cartridges or magazines. Since many of the conventional roll film machines are intended for library use, their design enables them to accept microfiche, jackets, and aperture cards as well. In most of these units the unit microforms are positioned manually.

Film Gate. For optimum sharpness of the screen image, the film must be held flat in the film plane. Two types of film gates are used for this purpose; they are:

1. *Open throat.* The film rides in open air. Such units normally use edge guiding or other methods to keep the film in the focal plane.
2. *Glass flats.* The film is held in the focal plane between two pieces of optically flat glass.

While the latter method will often provide the sharper image, the glass flats must be kept clean to minimize film damage. To further protect the film, these glass flats can be:

1. *Floating.* The flats pivot on a central axis so that they rotate with the film as it moves.
2. *Manual open* (and close). The flats must be separated manually each time the film is transported.
3. *Auto open* (and close). The flats open automatically when the film is moved.

Obviously each mechanization of a function contributes to cost and the purchaser can best weigh the above factors by his own experience.

The above factors and those noted in chapter II are compiled in the following tables. Table 1 covers the available readers in this equipment class; and table 2, the reader printers. To further assist the prospective purchaser or user, photographs of some of this equipment are shown in figure 5. The photographs were supplied through the courtesy of the manufacturers.

MICROFILM READERS – CONVENTIONAL FOR ROLL MICROFILM

MANUFACTURER/ DISTRIBUTOR	DASA	DIETZGEN	DUKANE	DUKANE	DUKANE
MODEL					
Number		4308	27A5	27A25	27A35
Name	Mark 1 model U			Explorer 14	Explorer 12
PHYSICAL					
Type	Desk	Desk	Portable	Desk	Desk
Dimensions (HWD)	27" x 13" x 17"	24" x 14" x 20"	22" x 11" x 19"	24" x 15" x 18"	20" x 11" x 12"
Weight (LBS)	27	28	22	45	15
ELECTRICAL					
Power (AC)	115V	115V	115V	115V	115V
Cooling	Blower	Convection	Convection	Blower	Convection
Rated Lamp Life	50 hours	150 hours	90-150 hours	100-150 hours	100 hours
OPTICAL					
Magnifications Available	15, 25, 35	17, 24, 30, 43	20	18	19
Lens Changeable	Yes	No	No	Yes	No
Image Rotation	Yes, mechanical	Yes, mechanical	Yes, mechanical	Yes, mechanical	No
SCREEN					
Size (H x W)	11" x 11"	12" x 12"	13" x 9"	14" x 14"	11" x 11"
Color	Green	Green	Gray	Gray	- - -
Type	Rear projection	Rear projection	Rear projection	Rear projection	Rear projection
FILM CARRIER					
Transport	Manual, crank	Manual, reel crank	Manual, reel crank	Manual, mechanical crank	Manual, reel crank
Film Sizes	16mm, 35mm	16mm, 35mm	16mm, 35mm	16mm,35mm	16mm, 35mm
Film Forms	Reel, jackets, microfiche, aperture cards	Reel, microfiche	Reel, microfiche, aperture cards, jackets	Reel, aperture cards, microfiche	Reel, Microfiche
Take Up	Reel	Reel	Reel	Reel	Reel
Film Gate	Glass flats, floating	Open throat	Glass flats	Glass flats	Glass flats manual open
Image Locator	Visual	Visual	Visual		Visual
CONTROLS					
Type	Focus, rotation, lateral scan, on-off, brightness	On-off, focus	On-off, brightness focus, rotation, lateral scan	On-off, brightness focus, rotation, lateral scan	On-off, focus, lateral scan
Location	All top	All front	All front	All front	All front
WARRANTY	90 days	90 days	90 days	90 days	90 days
SERVICE METHOD	Direct, dealer	Direct, dealer	Dealer, factory	Dealer, factory	Dealer, factory
FEATURES/ ACCESSORIES					
FED. GOVT. PRICES					
Reader	$455.00 commercial	$255.00-17X, 24X $267.75-30X, 43X	$207.50	$355.00	$150.00 (est)
Extra Lenses	$75.00 commercial				
Lamps	$1.71 commercial		$1.50	$7.50	
Service					

Table 1

KODAK (Recordak)	KODAK (Recordak)	REMINGTON RAND	UNIVERSITY MICROFILM	UNIVERSITY MICROFILM	UNIVERSITY MICROFILM	WASHINGTON SCIENTIFIC
MPE-1	310 model PVA	F420	1013	1212	1414	RH
Desk 39" x 21" x 21" 53	Desk 19" x 16" x 11" 23	Desk 27" x 13" x 17" 27	Desk 24" x 12" x 18" 22	Desk 18" x 14" x 8" 15	Desk 24" x 15" x 18" 45	Portable 19" x 14' x 18" (open) 18
117V Convection	117V Convection	115V Blower ---	115V & 220V Convection 100 hours	115V Blower ---	115V Blower 100 hours	Various AC, DC Convection 200 hours
19 No Yes, mechanical	20, 24, 32, 40 Yes Yes, mechanical	15, 24, 35 Yes Yes, mechanical	20 No Yes, mechanical	17, 22, 40 No No	18 No Yes, mechanical	20, 24 No No
20" x 20" White Reflecting	9" x 12" Green Rear projection	11" x 11" Green Rear projection	13" x 10" Gray Rear projection	12" x 12" Neutral Rear projection	14" x 14" Gray Rear projection	12" x 9" Green, gray, blue Rear projection
Manual, mechanical crank 16mm, 35mm Reel Reel Glass flats Codeline, visual	Manual 16mm Reel Reel Glass flats Codeline, visual	Manual mech. crank 16mm, 35mm Reel microfiche jackets Reel Glass flats floating Visual	Manual, reel crank 16mm, 35mm Reel microfiche Reel Visual	Manual 35mm microfiche 105mm x 148mm	Manual, mechanical crank 16mm, 35mm Reel microfiche Reel Glass flats manual open Visual	Manual, reel crank 16mm Reel Reel Open throat Codeline, visual
On-off, focus, film crank, rotation Top & side	On-off, focus, lateral scan, rotation, crank	On-off, focus crank, lateral scan, rotation Top	On-off, focus rotation, film crank	On-off, focus	On-off, focus film crank All front	On-off, focus manual crank Sides
Parts 1 year Service 3 months	Parts 1 year Service 3 months	1 year	90 days	90 days	90 days	180 days
Field on call	Field on call	Field offices	Xerox branches	Xerox branches	Xerox branches	Dealers
						Odometer option battery option
$850.00 less 6% $30.00 less 2%	$495.00 less 6% $65.00 less 6% $30.00 less 2%	$430-$455	$125.00 $19.00 $1.60 $20.00 minimum	$119.00 commercial	$275.00 $57.50 $10.08	$239.00 commercial $2.25

Table 1 — (Continued)

MICROFILM READER PRINTER – CONVENTIONAL FOR ROLL MICROFILM

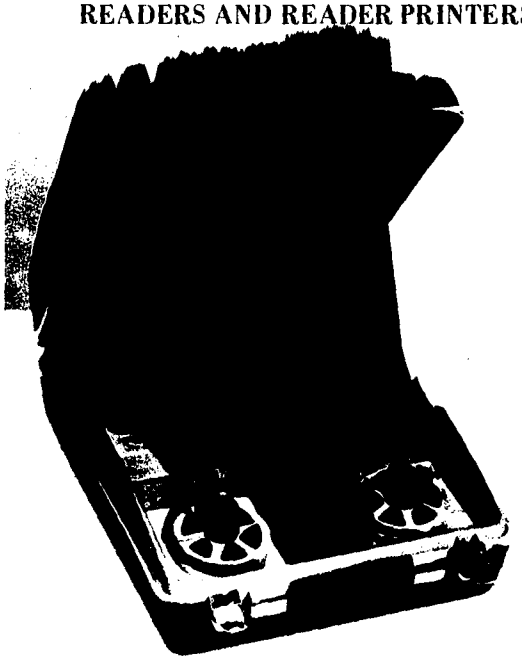
MANUFACTURER/ DISTRIBUTOR	DASA	DASA	3M
MODEL			
Number			400B model 75AA
Name	Mark II	Mark 18	
PHYSICAL			
Type	Desk	Stand or desk	Desk
Dimensions (HWD)	26"x13"x30"	33"x35"x36"	28"x17"x23"
Weight (LBS)	68	260	120
ELECTRICAL			
Power (AC)	115V	115V	115V, 220V
Cooling	Blower	Blower	Blower
Rated Lamp Life	50 hours	25 hours	---
OPTICAL			
Magnifications Available	10.5, 13.4, 15.4, 20.1, 27.9, 33.8	12, 14, 16	Range 11 lenses from 6.6 to 35
Lens Changeable	Yes	Yes	Yes
Image Rotation	Yes, mechanical	Yes, mechanical	Yes, mechanical
SCREEN			
Size (H x W)	11" x 11"	18" x 24"	11½" x 10"
Color	Green	Gray	Gray, green, blue
Type	Rear projection	Rear projection	Rear projection
FILM CARRIER			
Transport	Manual, mech. crank, continuous scan	Manual, continuous scan	Manual, mechanical crank
Film Sizes	16mm, 35mm	16mm, 35mm	16mm, 35mm
Film Forms	Reel aperture card 3" deep fiche	Reel aperture card microfiche	Reel aperture card microfiche
Take Up	Reel	Reel	Reel
Film Gate	Glass flats, floating	Glass flats, floating	Manual open glass flats
Image Locator	Image count	Visual	Visual
CONTROLS			
Type	On-off, brightness focus, rotation, scan print, expose manual transport	On-off, focus, film transport, lateral scan, rotation, expose, print	On-off, focus, film transport print, expose
Location	All top	All front	Side & front

Table 2

MANUFACTURER/ DISTRIBUTOR	DASA	DASA	3M
IMAGING SYSTEM			
Process	Silver stabilize	Silver stabilize	Electrochemical
Prints	Neg to positive	Neg to positive	Neg to positive
Warm Up Time	None	None	None
Print Cycle Time	25 seconds	25 seconds	6 seconds
Print Sizes	8½" x 11"	18" wide, variable 8½" to 24" long	8½" x 12½"
SUPPLIES			
Paper			
Roll Fed	150' roll	350' roll	300' roll
Sheet Fed			
Cost/Print	$.08	$.20	$.07 to .09
Shelf Life	18 months	18 months	
Chemicals			
Type	Silver stabilize	Silver stabilize	3M activator
Prints/Package	960	average 1500	300 per quart
WARRANTY	90 days	90 days	180 days
SERVICE METHOD	Direct & dealer	Direct & dealer	Agreement
FEATURES/ ACCESSORIES		Variable print length	Various, ½ sheet kit, odometer, stand, etc.
FED. GOVT. PRICES			
Reader/Printer	$1245.00 commercial	$3495.00 commercial	$872.20 w/o lens
Extra Lenses	$125.00 commercial	$300.00 commercial	$99.75
Lamps	$1.71 commercial	$8.56 commercial	
Service			$150/year

Table 2 (Continued)

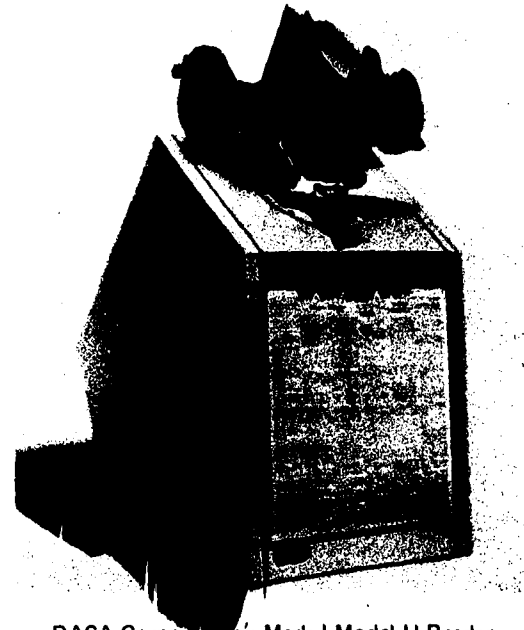
READERS AND READER PRINTERS FOR CONVENTIONAL ROLL MICROFILM



Washington Scientific Industries
Model RH Portable Reader

University Microfilms Reader Model 1414

...ty Microfil...
Model 1212 Reader



DASA Corpora...n's Mark I Model U Reader

Figure 5

IV. MOTORIZED ROLL FILM READERS AND READER PRINTERS

The majority of mechanized readers and reader printers use 16-mm. microfilm in containers called magazines, cartridges, or cassettes. Most of these units are designed to use one or more of the image-locating techniques described in chapter I under "Formats and Standards." At least one unit uses 16-mm. film with 8-mm. images in a duo (double row) sequence. These readers and reader printers vary greatly in their degree of sophistication and price. The degree of sophistication is related to the unit's retrieval capabilities.

In this category are:

1. A limited number of portable readers.
2. A number of desk model readers and reader printers.
3. One or more free-standing readers and reader printers.

Physical and Operational Characteristics

A standard 100-foot length of 16-mm. microfilm can accommodate 2,000 to 3,000 letter-size images. Thin base film can be put into a cartridge, thus doubling its capacity in pages. However, the user should be aware that thin base films do not work equally well in all reader and reader printer models, and many models require modification for thin base films.

The most widely used motorized readers consist of:

- A screen, either neutral in color or tinted blue or green.
- A slot or holder to accommodate the magazine or spindle for the supply reel.
- A film transport mechanism that either automatically threads the film through the machine and rewinds it into the magazine or transports manually threaded film.
- An optical projection and enlarging system.
- Controls: on-off, focus, and slow and fast motor drive for transporting film.
- On the manually controlled retrieval systems either an odometer indicator or an index scale along the screen. On automated retrieval systems, pushbutton control keyboards and logic circuitry for image location.
- A housing.

In addition, a reader printer has:

- A paper transport and printing mechanism.
- Additional controls for printing.

In order to display an image on the most widely used units, the user normally performs the following functions:

Turn switch on.

Insert cartridge.

Press lever or turn motor control knob to forward.

In manually controlled units, move film via control lever or knob to image location as indicated by the odometer or index strip on the screen. On automated units, press control buttons on panel for predetermined page location.

Focus.

To produce a print on a reader printer:

Set timer or exposure control.

Press print button.

The maintenance considerations discussed in chapters II and III pertain to this class of equipment as well. Because of the generally higher level of use of the motorized units however, it is even more important to perform preventive maintenance on the film gate and printing mechanism.

Special Factors in Equipment Selection

Applications for the equipment in this class are those systems involving high levels of reference to COM-generated roll film, listings and directories, catalogs and parts lists, indexes, maintenance literature, military and other specifications, and account status reports.

Film Transport. The units in this class, with one exception, are designed either to handle roll film, cartridges, and magazines with manual threading or to automatically feed or transport film using the cartridge, magazine, or cassette for which the unit was designed. One unit will automatically feed film from standard reels and can be adapted to unit microforms.

Film transport is controlled in one of three ways:

1. Using a lever similar to a light switch in which motion of the lever to the right makes the film go forward; and to the left, rewind.

2. Using a knob or dial which is turned clockwise for forward transport and counterclockwise for rewind.

3. Using a keyboard to step forward a predetermined number of images or to a predetermined image number.

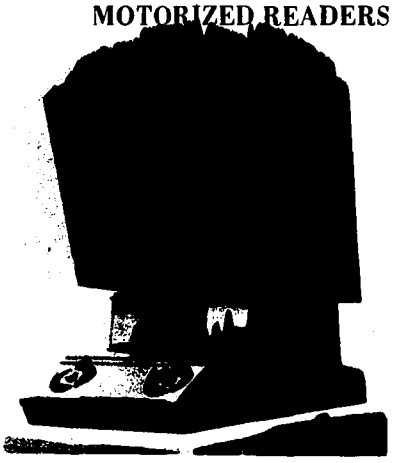
In addition, some units provide a manual control to assist in fine image positioning on the screen.

Since the method used to control film transport in the more automated units is often directly linked to the image finding method used on the film, the latter factor becomes a key one in equipment selection of the more automated type.

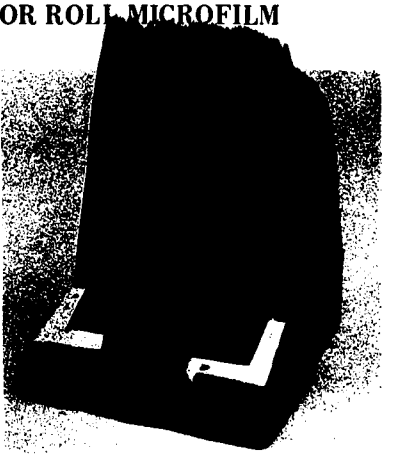
Film Gate. The methods described in chapter III for holding the film flat in the focal plane pertain here. In addition, a method identified in the equipment tables as "platen" is used. The platen is a floating-top glass flat in a holder that rides on edges designed to provide controlled glass-to-glass separation. In this method, care must be taken to be certain that the platen is the one designed for film of the thickness transported.

The general equipment selection factors referred to above and in chapter II are shown in tables 3 and 4 for readers and reader printers in this class. Photographs of typical units in this group are shown in figure 6.

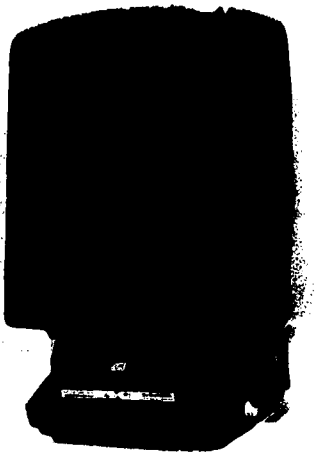
MOTORIZED READERS AND READER PRINTERS FOR ROLL MICROFILM



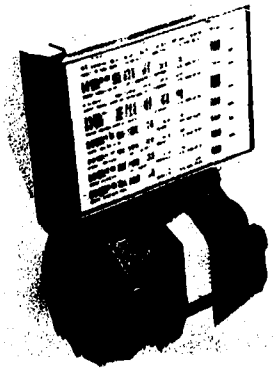
The 3M 400C Reader Printer



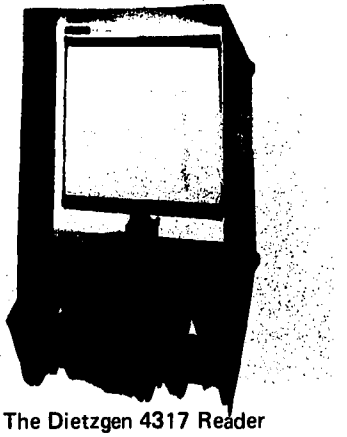
The Recordak Motormatic Reader, Model MPG



The Information Handling Services Satellite IIW Reader



The Ednalite 1624 COM Reader



The Dietzgen 4317 Reader

Figure 6

MICROFILM READERS – MOTORIZED FOR ROLL MICROFILM

MANUFACTURER/ DISTRIBUTOR	ATLANTIC MICROFILM	DIETZGEN	DIETZGEN
MODEL			
Number	WM-24m WM-40	4317	4317-M
Name	ATCOM		
PHYSICAL FEATURES			
Type	Desk	Desk	Desk
Dimensions (HWD)	17"x15"x13"	22"x15"x15"	22"x15"x15"
Weight (LBS)	15	30	30
ELECTRICAL			
Power (AC)	115V	115V	115V
Cooling	Blower	Blower	Blower
Rated Lamp Life	200 hours	150 hours	150 hours
OPTICAL			
Magnifications Available	24, 40	20	20
Lens Changeable	No	No	No
Image Rotation	No	No	No
SCREEN			
Size HxW	11" x 14"	12" x 12"	12" x 12"
Color	Gray	Green	Green
Type	Rear projection	Rear projection	Rear projection
Hood	Yes		
FILM CARRIER			
Transport	Motorized, dial control	Motorized continuous scan	Motorized
Film Sizes	16mm	16mm	16mm
Film Forms	No rewind cassette	Reel, 3M cartridge Recordak magazine microfiche	Reel, 3M cartridge Recordak magazine microfiche
Take Up	Cassette	Reel	Reel
Film Gate		Open throat	Open throat
Image Locator	Codeline	Visual	Odometer
CONTROLS			
Type	On-off, focus, brightness, film movement	On-off, focus, film movement	On-off, focus, film movement
Location	All front	All front	All front
WARRANTY	1 year, parts No labor	90 days	90 days
SERVICE METHOD	---	Direct, dealers	Direct, dealers
FEATURES, ACCESSORIES	Cassette carousel	Operates on side for rotation	
FED. GOVT. PRICES			
Reader	$350.00 commercial	$318.75	$361.25
Extra Lenses			
Lamps			
Service			

Table 3

EDNALITE	INFORM. HANDLING SERVICES	INFORM. HANDLING SERVICES	KODAK (RECORDAK)	KODAK (RECORDAK)
1624	Satellite II	Satellite IIW	MPG Motormatic	20/20
Desk 22"x15"x20" 32	Portable 17"x12"x16" 10½	Portable 19"x16"x16" 11	Desk 26"x23"x32" 70	Portable 21"x12"x18" 20
115V Blower 300 hours	115V & 220V Blower 450 hours	115V & 220V Blower 450 hours	120V Blower ---	117V or 12VDC Convection
24 No No	24, 40 No No	24, 40 No Yes, optical	19 or 23 Yes Yes, optical	20 No No
11½" x 14¼" Gray Rear projection	11" x 9" Gray Rear projection	11" x 14" Gray Rear projection	15" x 15" Neutral Rear projection	12" x 9" Green Rear projection
Motorized, continuous scan 16mm Reel Recordak magazine 3M cartridge Reel open Odometer	Manual or motorized 16mm (8mm image) Satellite 8/16 cassette Cassette Codeline, image	Manual or motorized 16mm Satellite 8/16 no rewind cassette Codeline, count	Motorized, dial control 16mm, 35mm Reel, Recordak thread-easy magazine Self thread Glass flats automatic open Codeline	Motorized 16mm Reel Recordak magazine Reel Open throat Codeline
On-off, focus, motor drive Front & side	On-off, brightness, focus, film transport, lateral scan Front & side	On-off, brightness, focus, film transport, lateral scan All front	On-off, focus, film transport, lateral scan, rotation All front	On-off, focus, motor drive All front
	90 days	90 days	Parts 1 year Service 3 months	Parts 3 months Service 3 months
	Agreement	Agreement	Field, on call	Field on call
	Pedestal, cassette rack	Pedestal, cassette rack	Unit record adaptor	
$625.00 commercial	$190.00 manual $265.00 motorized less 10% $7.80 less 10% $7.50/year	$275.00 manual $350.00 motorized less 10% $7.80 less 10% $12.50/year	$1175. w/o lens less 6% $120. less 6% $85.00 commercial	$485.00 reconditioned

Table 3 (Continued)

MICROFILM READERS – MOTORIZED FOR ROLL MICROFILM

MANUFACTURER/ DISTRIBUTOR	KODAK (Recordak)	KODAK (Recordak)	KODAK (Recordak)
MODEL			
Number	PR-1	PS-1-K	PTA
Name	Microstar	Lodestar	Starlet
PHYSICAL FEATURES			
Type	Desk	Desk	Desk
Dimensions (HWD)	24" x 25" x 38"	25" x 16" x 29"	21" x 14" x 19"
Weight (LBS)	140	90	32
ELECTRICAL			
Power (AC)	120V	120V	117V
Cooling	Blower	Blower	Blower
Rated Lamp Life			
OPTICAL			
Magnifications Available	18-24, 21-28, 27-36, 35, 45	23	20
Lens Changeable	Yes	No	No
Image Rotation	Yes, mechanical	Yes, optical	No
SCREEN			
Size (H x W)	14" x 14"	13 1/2" x 13 1/2"	10 7/8" x 12"
Color	Neutral	Green	Green
Type	Rear projection	Rear projection	Rear projection
Hood			
FILM CARRIER			
Transport	Motorized, continuous scan	Motorized, continuous scan	Motorized, manual, continuous scan
Film Sizes	16mm	16mm	16mm
Film Forms	Recordak magazine	Recordak magazine	Reel and Recordak magazine
Tape Up	Self thread	Self thread	Reel
Film Gate	Open	Open	Open throat
Image Locator	Codeline image count	Codeline image count	Codeline
CONTROLS			
Type	Motor drive, rotation, focus	Rotation, motor drive, speed lock, focus	On-off, focus, crank, motor drive
Location	All front	All front	All front
WARRANTY	Parts 1 year Service 3 months	Parts 1 year Service 3 months	Parts 1 year Service 3 months
SERVICE METHOD	Field on call	Field on call	Field on call
FEATURES/ ACCESSORIES	Zoom lens, control keyboard	Image control keyboard	
FED. GOVT. PRICES			
Reader	$1895.00 less 6%	$1295.00 less 6%	$575.00 less 6%
Extra Lenses	$95.00 less 6%		
Lamps			
Service	$100/yr comm.	$108/yr less 2%	$53/yr less 2%

Table 3 (Continued)

KODAK (Recordak)	3M	STROMBERG DATAGRAPHIX	WASHINGTON SCIENTIFIC	WASHINGTON SCIENTIFIC
PVM Starmatic	400CR	1700 Inquiry Station	C-3M Cartridge, or CR-Kodak Magazine	RM
Desk 19" x 20" x 12" 27	Desk 28" x 17" x 23" 120	Desk 21" x 18" x 18" 63	Portable 19" x 14" x 18" (open) 18	Portable 19" x 14" x 18" (open) 17
117V Convection	115V & 220V Blower	115V Blower 500 hours	Various AC & DC Convection 200 hours	Various AC & DC Convection 200 hours
20, 24, 32, 40 No Yes, mechanical	14.9, 18.3, 20.8, 23, 25, 29 Yes Yes, mechanical	24, 40 No No	20 or 24 No No	20 or 24 No No
9" x 12" Green Rear projection	11 1/2" x 10" Gray, green, blue Rear projection	11" x 14" Green, blue, gray Rear projection	12" x 9" Green, blue, gray Rear projection	12" x 9" Green, blue, gray Rear projection
Motorized, continuous scan 16mm Reel Reel Glass flats Codeline	Motorized, continuous scan 16mm 3M cartridge Self thread Platen Codeline, odometer optical codes	Motorized, stepped and continuous 16mm DatagraphiX cartridge Self thread Sequential retrieval marks	Motor, continuous scan 16mm 3M cartridge Recordak magazine Special hub Open Codeline odometer	Motorized 16mm Reel Reel Open Codeline odometer
On-off, focus, motor drive, rotation All front	On-off, focus, motor drive, crank, rotation Side & front	On-off, focus, motor drive All front	On-off, focus, film transport All front	On-off, focus, motor drive All front
Parts 1 year Service 3 months	180 days	30 days	180 days	180 days
Field on call	Agreement	Agreement	Dealers	Dealers
Lens kits	Stand, large screen kit		Various power options	Various power options
$685.00 less 6% $65.00 less 6% $30/yr less 2%	$926.10 w/o lens $99.75 $100	$1350-$1500 commercial $104.00 commercial $14.50/mo comm.	$389 (model C) $389 (model CR) commercial $2.25 commercial	$349.50 commercial $2.25 commercial

Table 3 (Continued)

MICROFILM READER PRINTERS – MOTORIZED FOR ROLL MICROFILM

MANUFACTURER/ DISTRIBUTOR	BELL & HOWELL	DASA	KODAK (Recordak)
MODEL			
Number		CRP-30	PE-1A
Name	Autoload		Magnaprint
PHYSICAL FEATURES			
Type	Desk	Desk	Desk
Dimensions (HWD)	29" x 22" x 34"	37" x 27" x 25"	29" x 17" x 27"
Weight (LBS)	117	175	105
ELECTRICAL			
Power (AC)	115V	115V	117V
Cooling	Blower	Blower	Convection
Rated Lamp Life	500 hrs	Not available	---
OPTICAL			
Magnifications Available	Zoom 20 to 40	12, 16, 18, 20, 24, 30, 33, 40	11.8, 13.7, 17.1, 19 22.5, 30, 38
Lens Changeable	---	Yes	Yes
Image Rotation	Yes, optical	Yes, mechanical	Yes, mechanical
SCREEN			
Size (H x W)	14" x 14"	12" x 14"	11" x 11"
Color	Blue	Hi contrast gray	Green
Type	Rear projection	Rear projection	Rear projection
FILM CARRIER			
Transport	Motorized, Continuous scan	Motorized, Continuous scan	Motorized, Continuous scan
Film Sizes	16mm	16mm	16mm, 35mm
Film Forms	B & H no rewind cartridge	Reel, cartridge, microfiche	Reel, Recordak magazine
Take Up	No rewind	Reel	Reel
Film Gate	Open	Open	Glass flats, Manual open/close
Image Locator	Codeline, odometer, visual	Image count	Codeline
CONTROLS			
Type	On-off, zoom, brightness, focus, scan, print, expose, rotation	On-off, focus, film transport, print, expose	On-off, focus, motor drive, expose, print
Location	All front	All front	All front

Table 4

KODAK (Recordak)	3M	3M	STROMBERG
PES-1 Lodestar	400C model 75AFYT	400M model 75AFB	1700-3500 Inquiry Station
Desk 31" x 16" x 33" 143	Desk 28" x 17" x 23" 120	Desk 28" x 17" x 23" 120	Console on stand 21" x 18" x 18" 346
117V Blower ---	115V Blower ---	115V, 220V Blower ---	115V Blower 500 hrs
23 (Reader) 21 (Printer) No No	14.9, 18.2, 20.8, 23, 25, 29 Yes Yes, mechanical	6.6, 8, 10.6, 12 14.9, 18.3, 20.8, 23, 25, 29, 35 Yes Yes, mechanical	20 or 40 No No
13" x 13" Green Rear projection	11½" x 10" Gray, green, blue Rear projection	11½" x 10" Gray, green, blue Rear projection	11" x 14" Blue, gray, green Rear projection
Motorized, Continuous scan 16mm Recordak magazine Self threading Open Codeline image count	Motorized, manual, continuous scan 16mm 3M cartridge Self thread Platen Codeline, visual, odometer, optical codes	Motorized, manual, continuous scan 16mm, 35mm Reel, microfiche, Aperture card Reel Glass flats Manual open Visual, codeline odometer	Motor, continuous scan and steps 16mm DatagraphiX Cartridge Self thread --- Sequential retrieval marks
On-off, focus, motor drive, speed lock, expose, print All front	On-off, rotation, film transport, lateral scan, expose, print Side & front	On-off, focus, film transport, lateral scan, rotation, expose, print All front	On-off, focus, motor drive, print All front

Table 4 (Continued)

MICROFILM READER PRINTERS — MOTORIZED FOR ROLL MICROFILM

MANUFACTURER/ DISTRIBUTOR	BELL & HOWELL	DASA	KODAK (Recordak)
IMAGING SYSTEM			
Process	Silver stabilize	OPC Electrostatic	Silver monobath
Prints	Neg. to positive	Neg. to positive Pos. to positive	Neg. to positive
Warm Up Time	None	None	---
Print Cycle Time	17 seconds	20 seconds	28 seconds
Print Sizes	8½" x 11" 8½" x 5½" (op)	8½" x 11"	8½" x 11¼"
SUPPLIES			
Paper			
Roll Fed	150' roll	300' roll	150' roll
Sheet Fed			
Cost/Print	$.10 max	$.025 to .035	---
Shelf Life	1 year	Indefinite	---
CHEMICALS			
Type	Activator Stabilizer	Toner, replenisher	Monobath
Prints/Package	500 per quart	1 qt. toner/roll	150
WARRANTY	90 days	90 days	Parts 1 year Service 3 months
SERVICE METHOD	Local	Direct & dealer	Field on call
FEATURES/ ACCESSORIES	½ size print kit, foot switch, roll film kit	3 models-manual, motorized, microfiche	Magazine adaptor Fiche adaptor
FED. GOVT. PRICES			
Reader/Printer		Commercial $1945.00 Motorized; $1750.00 manual, Microfiche	$1450.00 less 6%
Extra Lenses			$105.00 less 6%
Lamps			
Service			$132 less 2%

Table 4 (Continued)

KODAK (Recordak)	3M	3M	STROMBERG
Silver monobath	Electrochemical	Electrochemical	Electrostatic
Neg. to positive	Neg. to positive	Neg. to positive	Neg. to positive
None	None	None	5 seconds
Less than 30 seconds	6 seconds	6 seconds	10 seconds
8½" x 11"	8½" x 12½" 10½" x 8"	8½" x 12½"	8½" x 11" or 11" x 14"
150' roll	300' roll	300' roll	
	---	---	250 sheets/pkg
	$.07 to .09	$.07 to .09	$.025 & $.044

Monobath	3M activator	3M activator	Toner intensifier
150	300 per quart	300 per quart	4200 (8½" x 11")
Parts 1 year Service 3 months	180 days	180 days	30 days
Field on call	Agreement	Agreement	Agreement
Available only as reconditioned unit	Various-stand, ½ sheet kit, etc.	½ sheet kit, stand large screen kit various	Film annotate
$2100.00 less 6%	$1318.10 w/o lens	$1053.50 w/o lens	$2800.00 to $2950.00 commercial
	$99.75	$99.75	$104.00 commercial
$179 less 2%	$200/year	$200/year	$27 to $29/month

Table 4 (Continued)

V. MICROFICHE AND MICROFILM JACKET READERS AND READER PRINTERS

This chapter describes only microfiche readers and reader printers in the 15X to approximately 40X magnification range, using microfiche as described in chapter I. Most of the hardware operates in the range designated for the COSATI format, 18X to 20X; or in the NMA format at 22X to 26X. Readers and reader printers designed for microfiche can be used as well for microfilm jackets; therefore, all equipment in this class has been given the single designation, "microfiche."

Microfiche readers and reader printers are available in lap, portable, desk, and free-standing units as described in chapter II under "Physical Features."

Most microfiche readers display the image at approximately original size. An increasing number of microfiche readers have some means of determining or indicating the row and column index coordinates of the image being projected on the screen. Thus, these readers and reader printers also have limited retrieval capabilities as well.

Physical and Operational Characteristics

The microfiche reader is the simplest type of microfilm reader in current use. Accordingly, it is generally less expensive than a comparable roll film reader. Most microfiche readers are intended for desk use. Most of them consist of:

- A screen, either neutral color or tinted blue or green.
- Glass flats and a method to transport the microfiche from frame to frame.
- An optical projection and enlarging system.
- Controls: on-off, focus.
- Index grid or frame locator.
- A housing.

In addition, a reader printer has:

- A paper transport and printing mechanism.
- Additional controls for printing.

The user normally performs the following functions in order to display an image:

Turn switch on.

Open glass flats. (In some readers these open automatically when they are extended to a full forward position. Other units may require the flats to be opened manually.)

Insert microfiche (Readers differ. In some units, the microfiche must be inserted bottom edge first and right side up in order to project the image right reading on the screen. Another reader may require the microfiche to be inserted in a different position.)

Move film carrier to desired image as determined by index coordinates or by experiment.

Focus.

To produce a print on most reader printers:

Set print timer to proper exposure.

Actuate print mechanism.

Special Factors in Equipment Selection

Microfiche and jacket reference units are widely used for technical, research, and management reports; personnel and other "people"

files; parts and industrial catalogs; maintenance literature; library reference documents; and COM-generated microfiche.

Film Carrier. Any film carrier will accommodate its stated maximum sheet size and anything smaller. Normally, it is easiest to use a film carrier with microfiche or jackets of the same size. Smaller-size microfiche may be difficult to orient properly in larger film holders.

Practically all microfiche units use glass flats in the film carrier to hold the microform flat, protect it, and assist in image positioning. Some glass flats are removable for cleaning; if not, it should be possible to clean them in place easily.

In many units the glass flats are opened manually by raising the top flat to insert the microfiche. In others the flats open automatically, usually when the carrier is moved to the full forward position. Either method is quite convenient, and the choice is one of personal preference.

Image Location. With the microfiche in the carrier, image position or location can be indicated in several ways; they include:

X and Y coordinates. As the fiche is moved, X (column) and Y (row) coordinates related to the microfiche grid format are indicated on dials or scales by letter and number designators.

Grids. Location is indicated by a pointer on a grid located in front of the user and in the plane of the film carrier. Depending on the machine and the magnification, many manufacturers offer grids for COSATI, NMA, and special microfiche formats.

Film Transport. Motion of the film carrier to position images is provided in several ways:

- *Manual.* The film stage (in the absence of a carrier, the microfiche itself) is moved by hand in both the X and Y directions.
- *Dials.* The film carrier is moved by turning dials similar in appearance to the channel selector on a TV set.
- *Joystick.* The film stage is moved with a joystick or push-pull-rotate shaft.
- *Pointer.* Manual movement of the carrier is accomplished by holding the pointer which indicates location on the grid.
- *Automatic.* Motion is other than direct manual control, such as pushbuttons for X and Y coordinates on the microfiche.

With respect to film transport and image location, almost any combination of the above capabilities can be quite convenient. Hence the absence of some control of carrier motion and image location is almost totally unacceptable.

Table 5 lists the factors discussed here and in chapter II for microfiche readers. Reader printer information is provided in table 6. Several units are pictured in figure 7.

MICROFICHE READERS

MANUFACTURER/ DISTRIBUTOR	ATLANTIC	ATLANTIC	ATLANTIC
MODEL			
Number	F-66	F-66A	MJR
Name			
PHYSICAL			
Type	Desk	Desk	Portable
Dimensions (HWD)	20"x10"x16"	20"x10"x16"	22"x13"x17"(open)
Weight (LBS)	15	15	19
ELECTRICAL			
Power (AC)	115V, 220V	115V, 220V	120V
Cooling	Convection	Convection	Convection
Rated Lamp Life	100 hours	100 hours	100 hours
OPTICAL			
Magnifications Available	11, 15, 19, 22, 24, 35, 70	Any two 11, 15, 19, 22, 24, 35 70	7, 11, 15, 17, 22, 35
Lens Changeable	Yes	Yes	Yes
Image Rotation	No	No	No
SCREEN			
Size(HxW)	11" x 8½"	11" x 8½"	10" x 10"
Color	Gray	Gray	Gray
Type	Rear projection	Rear projection	Rear projection
Hood	Yes	Yes	No
FILM CARRIER			
Fiche Sizes Accepted	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8"	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8"	Up to 5" x 8"
Holder	Glass flats	Glass flats	Glass flats
Image Locator	X-Y coordinates	X-Y coordinates	None
Formats Avail.	COSATI, NMA, spec.	COSATI, NMA, spec.	---
Glass Flats	Automatic open	Automatic open	Manual open
Transport	Manual, dial	Manual, dial	Manual, joy stick
CONTROLS			
Type	On-off, brightness, film movement, focus	On-off, brightness, film movement, focus	On-off, focus, film movement
Location	All front	All front	Front and side
WARRANTY	Parts 1 year None on service	Parts 1 year None on service	Parts 1 year None on service
SERVICE METHOD	Factory return	Factory return	Factory return
FEATURES/ ACCESSORIES	Roll film attach handle, cover	Roll film attach handle, cover	Roll film attach
FED. GOVT. PRICES			
Reader	$107.10	$143.10	$178.20
Extra Lenses	$17.10	$17.10	$22.50
Lamps	$1.31	$1.31	$3.15
Service	$12.50/hr + parts	$12.50/hr + parts	$12.50/hr + parts

Table 5

ATLANTIC	BELL & HOWELL	BELL & HOWELL	BELL & HOWELL	DIETZGEN
P-50 Gypsy	Duo	Headliner	Mascot	4315
Portable 17"x13"16" (open) 11	Desk 24"x21"17" 60	Desk 24"x16"x19" 38	Portable 7"x13"x20" 16	Desk 24"x12"x15" 21
120/220V,12VDC Convection 100 hours	115V Blower Up to 1000 hours	115V Blower 500 hours	115/220V,12VDC Convection 500 hours	115V Convection 150 hours
22 (variable) Yes Rotate reader	22 or 30 No No	24 No Yes, optical	21 No No	19,25 No No
14"x14" up to 4'x4' wall projection --- Reflecting No	14"x20" Gray Rear projection Yes	14"x14" Blue Rear projection Yes	11"x11" Blue Rear projection Yes	12"x9½" Green Rear projection Yes
3"x5" 105mm x 148mm Glass flats Grid COSATI,NMA,spec. Automatic open Manual, joystick	3"x5" 105mm x 148mm 3 1/4" x 7-3/8" Glass flats Grid COSATI,NMA,spec. Removable Manual open Manual	105mm x 148mm Glass flats X-Y coordinates COSATI,NMA,spec. Removable Automatic open Dial	3"x5 105mm x 148mm Glass flats Grid COSATI,NMA,spec. Removable Automatic open Manual pointer	3"x5" 105mm x 148mm Glass flats None --- Manual open Manual
On-off, focus, film movement Various	On-off, brightness, focus, film move- ment Front and sides	On-off, focus, film movement rotation Front and side	On-off, focus, film movement Front and side	On-off, focus
Parts 1 year None on service	90 days	90 days	90 days	90 days
Factory return	Local offices	Local offices	Local offices	Local contract
12VDC adaptor battery pack			Foot for projection	
$54.00 $17.10 $1.31 $12.50/hr + parts	Not available	Not available	Not available	$137.70

Table 5 (Continued)

MICROFICHE READERS

MANUFACTURER/ DISTRIBUTOR	DIETZGEN	DIETZGEN	GAF CORP.
MODEL			
Number	4316	4319	D7500
Name			
PHYSICAL			
Type	Desk	Desk	Desk
Dimensions (HWD)	25" x 21" x 19"	24" x 12" x 16"	18½" x 9½" x 16"
Weight (LBS)	56	21	---
ELECTRICAL			
Power (AC)	115V	115V	115V or 220V
Cooling	Blower	Convection	Blower
Rated Lamp Life	50 hrs	150 hrs	550 hrs
OPTICAL			
Magnifications Available	22, 30, 42	19, 25	18, 24
Lens Changeable	No	No	Yes
Image Rotation	No	No	No
SCREEN			
Size (H x W)	14" x 20"	12" x 9½"	11" x 8½"
Color	Gray	Green	Green, blue, gray
Type	Rear projection	Rear projection	Rear projection
Hood	Yes	Yes	---
FILM CARRIER			
Fiche Sizes Accepted	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8"	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8"	Up to 5" x 8"
Holder	Glass flats	Glass flats	Glass flats
Image Locator	Grids	X-Y coordinates	Grids
Formats Avail.	COSATI, NMA, spec.	COSATI, NMA	COSATI, NMA, DOD
Glass Flats	Automatic open	Manual open	Removable Manual open
Transport	Manual	Manual	Manual
CONTROLS			
Type	On-off, focus	On-off, focus	On-off, focus, film movement
Location	All front	Front	All front
WARRANTY	90 days	90 days	180 days
SERVICE METHOD	Local contract	Not available	Field service
FEATURES/ ACCESSORIES			
FED. GOVT. PRICES			
Reader	$340.00	$176.80	$129.00 commercial
Extra Lenses			
Lamps			$4.00 commercial
Service			

Table 5 (Continued)

GAF CORP.	KEUFFEL & ESSER	KEUFFEL & ESSER	KODAK (Recordak)	KODAK (Recordak)
D7502	52 9921	52 9922	PFCS Esamatic	PFCD Esamatic
Desk 19" x 16" 25" ---	Desk 18" x 25" x 18" 70	Desk 18" x 35" x 25" 75	Desk 19" x 19" x 21" 20	Desk 19" x 19" x 21" 20
115V or 220V --- ---	115V Blower 2000 hours	115V Blower 2000 hours	120V Blower Not available	120V Blower Not available
24, 42 Yes No	24 and 30 No Yes	24 and 30 No No	18.5, 21.5, 23, 25.5, 31 Yes No	18.5, 21.5, 23 25.5, 31 Yes No
11½" x 15½" Gray, blue, green Rear projection ---	15" x 14" Gray Rear projection No	14" x 22" Gray Rear projection No	11" x 11" Neutral Rear projection No	11" x 16" Neutral Rear projection No
Up to 5" x 8" Glass flats Grid NMA, COSATI, DOD Removable Manual open Manual	Up to 6" x 8" Glass flats X-Y coordinates COSATI, NMA Removable Manual dials	Up to 6" x 8" Glass flats X-Y coordinates COSATI, NMA Removable Manual dials	105mm x 148mm 3 1/4" x 7 3/8" Glass flats Grid COSATI, NMA, DOD Removable, Manual open Manual, pointer	105mm x 148mm 3 1/4" x 7 3/8" Glass flats Grid COSATI, NMA, DOD Removable, Manual open Manual, pointer
On-off, focus, All front	On-off, focus, film transport All front	On-off, focus, film transport All front	On-off, focus, film movement All front	On-off, focus film movement All front
180 days	90 days	90 days	Parts - 1 year Service - 3 months	Parts - 1 year Service - 3 months
Field service	Local offices	Local offices	Field, on call	Field, on call
			Lens kits special cover glass	Lens kits special cover glass
$265.00 commercial $8.50 commercial	$300.00 commercial $10.00 commercial	$400.00 commercial $10.00 commercial	$180.00 31X$225.00 Less 6% $20.00 31X$65.00 Less 6% Not available $30.00/yr, less 2%	$205.00 31X$250.00 Less 6% $20.00 31X$65.00 Less 6% --- $30.00/yr, less 2%

Table 5 (Continued)

MICROFICHE READERS

MANUFACTURER/ DISTRIBUTOR	KODAK (Recordak)	MICRO DESIGN	MICRO DESIGN
MODEL			
Number	PK-1013	100	COM 200
Name			
PHYSICAL			
Type	Desk	Desk	Desk
Dimensions (HWD)	27" x 13" x 18"	18" x 9" x 16"	19" x 16" x 25"
Weight (LBS)	39	17	33
ELECTRICAL			
Power (AC)	115V	115V	115V
Cooling	Convection	Not available	Blower
Rated Lamp Life	40 hrs	500 hrs	700 hrs (low)
OPTICAL			
Magnifications Available	18 or 23	18 & 24	24 & 42
Lens Changeable	Yes	No	No
Image Rotation	Yes-optical	No	No
SCREEN			
Size (H x W)	13 1/4" x 10 1/2"	11" x 8 1/2"	11 1/2" x 15 1/2"
Color	Green	Green or gray	Green or gray
Type	Rear projection	Rear projection	
Hood	No	No	Yes
FILM CARRIER			
Fiche Sizes Accepted	105mm x 148mm 3 1/4" x 7 3/8", 3" x 5", 5" x 8"	105mm x 148mm 3 1/4" x 7 3/8" 3" x 5"	105mm x 148mm 3 1/4" x 7 3/8" 3" x 5"
Holder	Glass flats	Glass flats	Glass flats
Image Locator	X-Y coordinates	Grid	Grid
Formats Avail.	COSATI, NMA	COSATI, NMA, spec.	COSATI, NMA, spec.
Glass Flats	Removable Manual open	Removable Manual open	Removable Automatic open
Transport	Manual dial	Manual pointer	Manual pointer
CONTROLS			
Type	On-off, focus, film movement, rotation	On-off, focus, film movement	On-off, brightness, focus, film movement
Location	All front	Front and side	Front and side
WARRANTY	Parts - 3 months Service - 3 months	1 year	1 year
SERVICE METHOD	Field, on call	Local dealer	Local dealer
FEATURES/ ACCESSORIES		Wall projection 16mm roll attach.	Wall projection screen tilt
FED. GOVT. PRICES			
Reader	$430.00 Less 6%	$116.10	$238.50
Extra Lenses			
Lamps			
Service	$42.00/yr, less 2%		

Table 5 (Continued)

MICRO IMAGE	NCR	NCR	NCR	NCR
MICRA 210	476-300	456-316	456-400	456-800
Desk 16" x 13" x 9" 12	Portable 21" x 12" x 8" 15	Portable 16" x 8" x 11" 15	Desk 21" x 16" x 18" 35	Desk 24" x 19" x 20" 65
115V Blower 1000 hrs	115/220V, 12VDC Convection Not available	115V Convection Not available	115V, 220V Convection Not available	115V Blower Not available
14, 18, 31 Yes No	18, 21, 24, 26, 38 Yes No	Dual 16 & 22 No No	18, 21, 24, 26 No No	22, 26, 33, 38 No No
9" x 11" Blue Rear projection No	10 1/2" x 9 1/2" Green, gray, bronze Rear projection No	8 3/4" x 6 3/4" Green Rear projection Yes	11 7/8" x 11" Green or gray Rear-projection Yes	13 1/4" x 19 3/4" Green Rear projection Yes
105mm x 148mm 3" x 5" Glass flats Grid COSATI, NMA, COM Removable Automatic open Manual pointer	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8" Glass flats Grid COSATI, NMA, spec. Removable Automatic open Manual pointer	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8" Glass flats None None Removable Manual open Manual	105mm x 148mm 3" x 5", 6" x 8" 3 1/4" x 7 3/8" Glass flats Grid COSATI, NMA, spec. Removable Automatic open Manual pointer	105mm x 148mm 3" x 5", 6" x 8" 3 1/4" x 7 3/8" Glass flats Grid COSATI, NMA, spec. Removable Automatic open Manual pointer
On-off, focus, film movement All front	On-off, focus, brightness All front	On-off, focus, magnification Top, front, side	On-off, focus, brightness All front	On-off, focus, brightness, film movement All front
180 days		1 yr on parts	90 days parts and labor	90 days parts and labor
Return to factory		Return factory	Local branches	Local branches
Swivel base carrying case	Carry case			
$99.00 Comm. with 14X lens $15.00 for 14X lens $5.00	$250.00 commercial $27.00/year	$125.00	$178.50 (18X, 24X) $204.25 (21X, 26X) $27.00/year	$361.00 (22X) $376.25 (26X, 33X) $403.75 (38X) $27.00/year

Table 5 (Continued)

MICROFICHE READERS

MANUFACTURER/ DISTRIBUTOR	NCR	POST	READEX
MODEL			
Number	456-942	640	Universal Micro-
Name			viewer
PHYSICAL			
Type	Desk	Desk	Desk
Dimensions (HWD)	22"x19"x21"	17½"x14"x15"	23"x11"x20"
Weight (LBS)	65	40	24
ELECTRICAL			
Power (AC)	115V, 220V	115V, 220V	115V
Cooling	Blower	Blower	Convection
Rated Lamp Life	Not available	40 hrs	100 hrs
OPTICAL			
Magnifications Available	42	18 & 24	23
Lens Changeable	Yes	No	No
Image Rotation	No	No	Yes
SCREEN			
Size HxW	12" x 18½"	11" x 14"	12 3/8" x 9 3/4"
Color	Green	Green, blue, gray	Green
Type	Rear projection	Rear projection	Rear projection
Hood	Yes	Yes	Yes
FILM CARRIER			
Fiche Sizes Accepted	105mm x 148mm 3" x 5", 6" x 8" 3 1/4" x 7 3/8"	7 7/16" x 7 7/16" or under	6" x 9"
Holder	Glass flats	Glass flats	Glass flats
Image Locator	Grid	X-Y coordinates	None
Formats Avail.	COSATI, NMA, COM	COSATI, special	None
Glass Flats	Removable Automatic open	Manual open	Manual open
Transport	Manual pointer	Manual	Manual
CONTROLS			
Type	On-off, focus brightness film movement	On-off, focus brightness	On-off, focus rotation, film movement
Location		All front	Front, top, side
WARRANTY	90 days parts and labor	6 months	1 year
SERVICE METHOD	Local branch	Field, on call	
FEATURES/ ACCESSORIES			Accepts opaques also
FED. GOVT. PRICES			
Reader	$296.00 commercial	$201.65	$295.00 commercial
Extra Lenses			
Lamps			$1.00
Service	$27.00/year		

Table 5 (Continued)

REALIST	REALIST	REALIST	REALIST	REALIST
3320	3330	3332	3333	3334
Desk 22"x19"x21" 55	Desk 22"x19"x21" 55	Desk 22"x19"x21" 55	Desk 22"x19"x21" 55	Desk 22"x19"x21" 55
115V Blower 380 or 500 hrs	115V Blower 500 hrs	115V Blower 380 hrs	115V Blower 380 hrs	115V Blower 250 hrs
22, 24, 30, 40 No No	24 No No	24, 30, 43 No No	26, 27, 50 No No	Dual lens 11.5 and 24 No No
13" x 15" Gray or green Rear projection No	12" x 11" Gray, green Rear projection No	13" x 19" Gray, green Rear projection No	13" x 19" Not available Rear projection No	13" x 19" Not available Rear projection No
105mm x 148mm 6" x 8"	105mm x 148mm 6" x 8"	105mm x 148mm 6" x 8"	105mm x 148mm 6" x 8"	6" x 8"
Glass flats Grid COSATI, NMA, spec. Removable Automatic open Manual	Glass flats Grid COSATI, NMA Removable Automatic open Manual	Glass flats Grid COSATI, NMA, spec. Removable Automatic open Manual	Glass flats Grid, COSATI, NMA, spec. Removable Automatic open Manual	Glass flats Grid, X-Y coords. COSATI, NMA, spec. Removable Automatic open Manual
On-off, focus, brightness film movement All front	On-off, focus brightness film movement All front	On-off, focus brightness film movement All front	On-off, focus brightness film movement All front	On-off, focus brightness film movement All front
1 year on parts except lamp	1 year on parts except lamp	1 year on parts except lamp	1 year on parts except lamp	1 year on parts except lamp
Dealers, factory	Dealers, factory	Dealers, factory	Dealers, factory	Dealers, factory
Fiche storage turntable, stand	Fiche storage turntable, stand	Fiche storage, turntables, stand	Fiche storage turntable, stand	Stand, cover turntable
$291.00 $5.75 or $3.75	$220.00 $3.75	$334.00 $5.75	$353.00 $5.75	$400.00 $5.90

Table 5 (Continued)

MICROFICHE READERS

MANUFACTURER/ DISTRIBUTOR	REMINGTON RAND	REMINGTON RAND	STROMBERG
MODEL			
Number	F400	F450	1325
Name	Mini Reader	Kard-A-Film	Inquiry Station
PHYSICAL			
Type	Portable	Desk	Desk
Dimensions (HWD)	8" x 9" x 7"	17" x 16" x 15"	21" x 18" x 21"
Weight (LBS)	2½	35	60
ELECTRICAL			
Power (AC)	115V	115V	115V
Cooling	Convection	Blower	Blower
Rated Lamp Life		Not available	130 hrs.
OPTICAL			
Magnifications Available	15, 17, 23; Dual 15/19, 17/21 23/33	18, 24	24 & 40
Lens Changeable	No	No	Yes
Image Rotation	No	No	No
SCREEN			
Size (H x W)	5½ x 7¾	11" x 14"	11" x 14"
Color	Gray	Blue	Green, blue, gray
Type	Rear projection	Rear projection	Rear projection
Hood	No	Yes	Optional
FILM CARRIER			
Fiche Sizes Accepted	Up to 5" x 8"	Up to 7 3/8" x 7 3/8"	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8"
Holder	Open throat	Glass flats	Glass flats
Image Locator	None	X-Y coordinates	Grid
Formats Avail.	---	CASATI, NMA	DatagraphiX
Glass Flats	---	Removable Automatic open	Removable Manual open
Transport	Manual	Manual	Manual, pointer
CONTROLS			
Type	On-off, focus	On-off, focus, brightness	On-off, focus, film movement
Location	Rear & front	All front	All front
WARRANTY	1 year	1 year	30 days
SERVICE METHOD	Local	Local	Contract
FEATURES/ ACCESSORIES	Carry case Battery pack		Combines with 3500 printer unit
FED. GOVT. PRICES			
Reader	$69.50 to $90.00 Commercial	$249.00 Commercial	$330.00 Commercial
Extra Lenses			$104.00 Commercial
Lamps			Not available
Service			$3.45/month, comm.

Table 5 (Continued)

TAYLOR-MERCHANT	TAYLOR-MERCHANT	TAYLOR-MERCHANT	WASHINGTON SCIENTIFIC
300	16 & 12 Microviewer	12AMB; 16AMB Microviewer	MF
Portable 6" x 3" x 8" 3	Hand held 2" x 3" x 5" 7 oz	Hand held 2" x 2" x 6" 7 oz	Portable 19" x 14" x 18" (open) 16
115V Blower Not available	Battery --- ---	Ambient light --- ---	115/220V, DC, spec. Convection 200 hrs
Variable by projection No No	16 & 12 No No	12 (12 AMB) 16 (16 AMB) No No	20 & 24 No No
Uses any available screen --- Reflecting No	No screen Monocular reader --- --- ---	No screen Monocular reader --- --- ---	12" x 9" Green, blue, gray Rear projection Yes
3" x 5" 105mm x 148mm 3 1/4" x 7 3/8" Open throat None --- --- Manual	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8" Open throat None --- --- ---	All sizes up to 6" x 9" Open throat None --- --- Manual	3" x 5" 105mm x 148mm Glass flats Grid COSATI, NMA, spec. Removable Automatic open Manual, joy stick
On-off, focus On cord, front	On-off, focus Rear & front	Focus Front	On-off, focus, film movement All front
90 days	90 days	90 days	180 days
Return factory	Return factory	Return factory	Dealers
			Battery option, Automobile kit
$59.50 $2.75	$17.95 (12X) $19.95 (16X) $1.00 plus parts	$15.95 $1.00 plus parts	$199.00 commercial On request $2.45 commercial Not available

Table 5 (Continued)

MICROFICHE READER PRINTERS

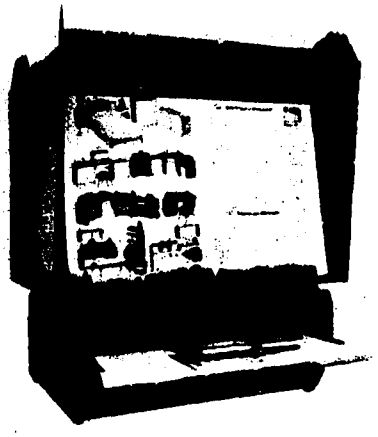
MANUFACTURER/ DISTRIBUTOR	BELL & HOWELL	DASA	KODAK (Recordak)	3M	3M	STROMBERG
MODEL						
Number			PFC-1A		400F model 75AAM	1325/3500
Name	Reporter	Mark II		Executive I		Inquiry Station
PHYSICAL						
Type	Desk	Desk	Desk	Desk	Desk	Console on stand
Dimensions (HWD)	29"x18"x25"	26"x14"x30"	29"x17"x27"	24"x18"x25"	28"x17"x23"	21"x18"x21"
Weight (LBS)	145	68	100	40	120	346
ELECTRICAL						
Power (AC)	115V	115V	117V	115V	115V & 220V	115V
Cooling	Blower	Blower	Convection	Convection	Blower	Blower
Rated Lamp Life	500 hours	50 hours				130 hours
OPTICAL						
Magnifications Available	18, 21, 24	10.5, 13.4, 15.4, 20.1, 27.9, 33,8	11.8, 13.7, 17.1, 19, 22.5, 30, 38	20, 24	6.6, 8.1, 10.6, 12.1, 14.9 18.3, 20.8, 23, 25, 29, 35	24, 40
Lens Changeable	Yes	Yes	Yes	Yes	Yes	Yes
Image Rotation	No	No	Yes, mechanical	No	Yes, mechanical	No
SCREEN						
Size (H x W)	11" x 11"	11" x 11"	11" x 11"	12" x 12"	11½" x 10"	11" x 14"
Color	Gray	Green	Green	White	Gray, green, blue	Green, blue, gray
Type	Rear projection	Rear projection	Rear projection	Rear projection	Rear projection	Rear projection
Hood	Yes	No	Yes	No	Yes	---
FILM CARRIER						
Fiche Sizes Accepted	3" x 5" 105mm x 148mm	3" x 5" 105mm x 148mm	105mm x 148mm 3 1/4" x 7 3/8"	Up to 4" x 8"	Up to 6" x 8"	3" x 5" 105mm x 148mm 3 1/4" x 7 3/8"
Holder	Glass flats	Glass flats	Glass flats	Glass flats	Glass flats	Glass flats
Image Locator	Grid	X-Y coordinates	X-Y coordinates	Grid	X-Y coordinates	Grid
Grids Available	COSATI, NMA, spec.	---	---	COSATI, NMA, spec.	COSATI, NMA, ANSI	DatagraphiX
Glass Flats	Removable, automatic open	Manual open	Removable, manual open	Removable, automatic open	Removable, manual open	Removable, manual open
Transport	Manual pointer	Manual dial	Manual	Manual pointer	Manual	Manual pointer
CONTROLS						
Type	Film movement, expose, print, On-off, focus	On-off, focus, film movement, expose, print	On-off, focus, expose, print, film movement, rotation	On-off, focus, film movement, expose, print	On-off, focus, film movement, rotation, expose, print	On-off, focus, print
Location	All front	Side & top	All front	All front	Front and side	All front

Table 6

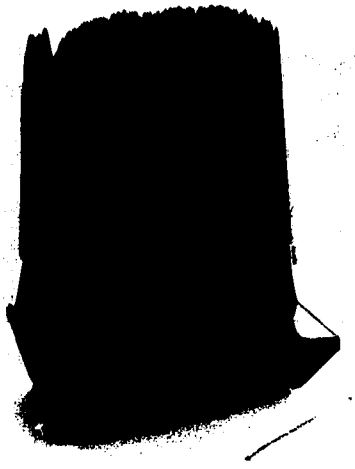
MANUFACTURER/ DISTRIBUTOR	BELL & HOWELL	DASA	KODAK (Recordak)	3M	3M	STROMBERG
IMAGING SYSTEM						
Process	Electrostatic	Silver stabilize	Silver monobath	Dry silver	Electrochemical	Electrostatic
Prints	Neg to pos, pos to pos (change toner)	Neg to positive	Neg to positive pos to negative	Neg to positive	Neg to positive	Neg to positive
Warm Up Time	None	None	None	2 to 3 mins	None	5 seconds
Print Cycle Time	8 seconds	25 seconds	28 seconds	30 seconds	6 seconds	10 seconds
Print Sizes	8½" x 11"	8½" x 11"	4" x 11", 5½" x 11", 8½" x 11"	8½" x 11"	8½" x 12½" 8" x 10¾"	8½" x 11" or 11" x 14"
SUPPLIES						
Paper						
Roll Fed		150' roll	150' roll		300' roll	
Sheet Fed	250 sheets/pkg			100 sheets/pkg		250 sheets/pkg
Cost/Print	$.05 max	$.08		$.10	$.07 to .0	$.025 (8½" x 11")
Shelf Life	1 year	18 months		6 months		Indefinite
Chemicals						
Type	Positive or reversal toner	Silver stabilize	Monobath	None	Activator	Toner intensifier
Prints/Package	Avg. 800/pint	960	150		150/pint	4200
WARRANTY	90 days	90 days	Parts 1 year Service 3 months	180 days		30 days
SERVICE METHOD	Local offices	Direct, dealer	Field on call	Agreement	Agreement	Agreement
FEATURES/ ACCESSORIES			Magazine adaptor, paper width adaptors, etc.		½ sheet kit, stand, etc.	Hood
FED. GOVT. PRICE						
Reader/Printer	$1442.90 w/o lens	$1245.00 commercial	$1350.00 less 6%	$325.00 commercial	$852.60 w/o lens	$1780.00 commercial
Extra Lenses	$56.40	$125.00 commercial	$105.00 less 6%		$99.75	$104.00 commercial
Lamps	$3.75	$1.71				
Service	$155 to $840/yr				$150/year	

Table 6 (Continued)

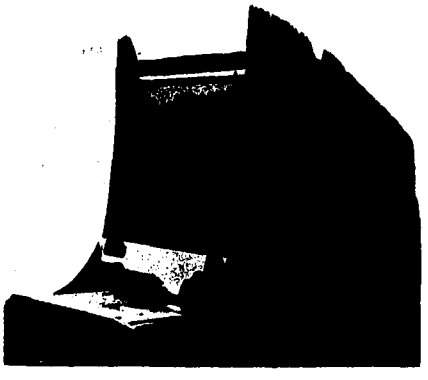
MICROFICHE RETRIEVAL UNITS



N.C.R. Model 456-800 Reader Series



The Micra 210 Reader
Micro Image Corp.



The COM 200 Reader
Micro Design, Inc.

The Dietzgen 4315 Reader

The Realist Model 3334

Figure 7

VI. APERTURE CARD READERS AND READER PRINTERS

The microfilm aperture card is widely used for engineering drawings and related design documents. Except for a very few special formats, the MIL-D card format containing a frame of 35-mm. film up to 1.9 inches in length mounted in an aperture in the right end of the card is used. Reductions of 16, 24, and 30 diameters are used to record drawing sheets up to 36 x 48 inches or sections this large of 36-inch roll drawings. At these reductions, up to 4, 8, and 15 letter-size pages of support documents can also be microfilmed on one frame. In some systems, a reduction of 36X is used to record drawings up to 42 inches wide.

Units in this class include those that have large screens or film transports designed primarily for scanning aperture cards. In this category are:

1. A limited number of portable readers, including an aperture card projector.
2. Desk top readers for individual and small group use.
3. Desk model and free-standing reader printers.

Physical and Operational Characteristics

In general terms, the 18- x 24-inch screen readers and reader printers use a nominal magnification of 15X to display all of the image in the MIL-D aperture. Accordingly, a reduced image is displayed or printed for larger documents. Reduced-size images are convenient to use and perfectly adequate when today's drafting and document preparation standards are followed.

Most of the smaller screen readers for aperture cards also provide a nominal enlargement of 15X, and the user views pertinent sections of larger document images by scanning the aperture. Scanning is manual on one unit. In the others, the card is held between glass flats, and the image scanned using a joystick, lever, or knob. Two of the units provide a two-lens projection system to enable the user to view all of the image in the aperture at a lower magnification and selected portions at 15X.

Several of the desk top readers for microfiche noted in the previous chapter can also be used for aperture card reference. Thus, the user may wish to consider those that handle microforms to tab card size (3.25 x 7.375 inches), provide enlargement in the range 15 to 24X, and provide scanning.

Aperture card readers are fairly simple devices consisting of:

- The aperture card holder.
- An optical projection and enlarging system.
- Translucent screen.
- Controls: on-off, focus, scan.
- A housing.

In addition, the reader printers have:

- Paper transport and printing mechanism.
- Print exposure, size, and other controls.

The user normally performs the following functions:

Turn switch on.

Place card in holder and position the image or portion of the image desired.

Focus.

When a print is desired:

Set control for proper exposure.

On units so equipped, set control for optimum paper usage.

Actuate print mechanism.

On most units very little maintenance will be necessary, but preventive maintenance, as described in chapter II, will pay dividends.

Special Factors in Equipment Selection

Applications for the units in this class include reference to aperture cards of engineering drawings; design support documents such as specifications, bills of material, and change notices; and test data and other technical reports.

Screen Size. Depending on the nature of the user's reference to the information, screen size will be an important consideration. For users who need reference only to part numbers, details, or sections of documents, a small-screen, desk top viewer may be perfect. For others, an 18- x 24-inch screen may be necessary to allow them to view an entire image. All the reader printers have screens which will handle magnification of the full aperture card frame.

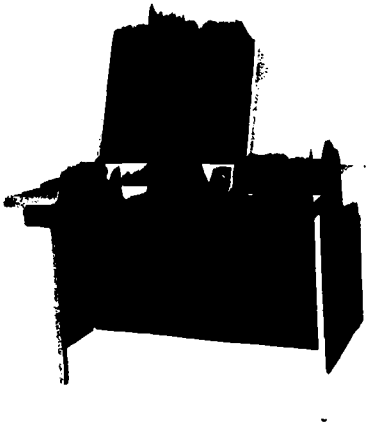
Film Carrier. Several of the units in this category will handle other unitized microforms, and several will also accept roll film. For some users, this added flexibility may be important.

In almost all the readers in this class, the aperture card and film are held between glass flats. In one exception, the card is held in a very similar holder.

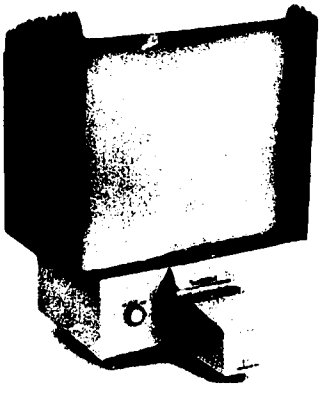
Film transport in all of the large screen units in this class is manual by positioning the card in the film carrier. In the smaller screen, desk top and portable readers, scanning may be done either manually or by means of a joystick or lever. The choice is one of personal preference.

Figure 8 shows equipment typical of this class of readers and reader printers. Equipment selection factors are tabulated in table 7 for readers and table 8 for reader printers.

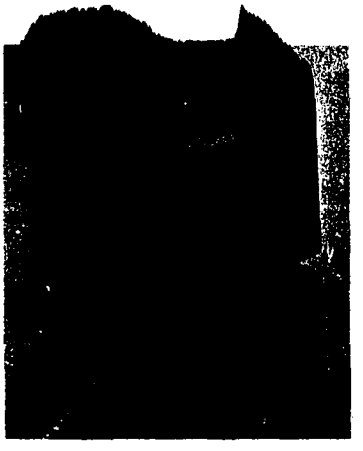
READERS AND READER PRINTERS FOR APERTURE CARDS



The Itek 18.24 Reader Printer

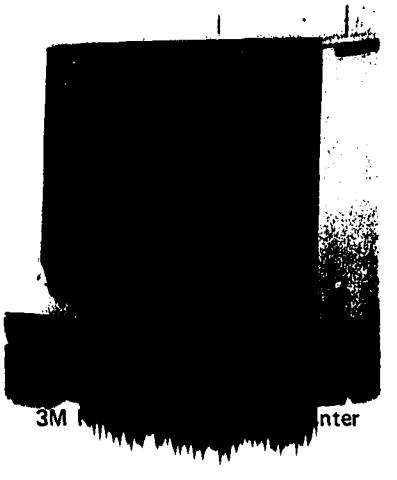


The Normandale Reader
Washington Scientific Industries



The Dietzgen Model 4314 Reader

Washington Scientific Industries
Quadri-Scan Portable Reader



3M [illegible] nter

Figure 8

APERTURE CARD READERS

MANUFACTURER/ DISTRIBUTOR	DASA	DIETZGEN	DIETZGEN	DIETZGEN	B. K. ELLIOTT
MODEL					
Number		4305	4313-A	4314	
Name	Draftsman				Project 1
PHYSICAL					
Type	Desk	Desk	Desk	Desk	Desk
Dimensions (HWD)	31" x 26" x 30"	24" x 16" x 19"	25" x 25" x 29"	22" x 13" x 13"	24" x 22" x 22"
Weight (LBS)	120	22	---	22	30
ELECTRICAL					
Power (AC)	115V	115V	115V	115V	115V
Cooling	Blower	Convection	Blower	Convection	Blower
Rated Lamp Life	200 hours	150 hours	50 hours	150 hours	50 hours
OPTICAL					
Magnifications Available	15	15 or 20	14.75	15 and 20	12
Lens Changeable	No	No	No	No	No
Image Rotation	No	No	No	No	No
SCREEN					
Size	18" x 24"	12" x 10½"	18" x 24"	10½" x 12"	15" x 22"
Color	Gray	Green	Green	Green	Gray
Type	Rear projection	Rear projection	Rear projection	Rear projection	Rear projection
Hood	No	Yes	Yes	---	No
FILM CARRIER					
Card Sizes Accepted	Aperture card	Aperture card	Aperture card, roll film (adapt)	Aperture card	Aperture card
Holder	Open throat	Glass flats	Glass flats	Glass flats	Glass flats
Glass Flats		Manual open	Manual open	Manual open	Manual open
Transport	Manual	Manual, joystick	---	Joystick, manual	Manual
CONTROLS					
Type	On-off, focus, film movement	On-off, focus	On-off, focus	On-off, focus, film scan	On-off, focus
Location	All front	Top & side	Front & side	All front	
WARRANTY	90 days	90 days	90 days	90 days	30 days
SERVICE METHOD	Direct & dealers	Direct, dealers	Direct, dealers	Local contract	---
FEATURES/ ACCESSORIES	Roll film adaptor, legs		Roll film adaptor		
FED. GOVT. PRICES					
Reader	$595.00 commercial	$168.73 (15X) $201.03 (20X)	$607.75 (4313A) $637.50 (4313AR)	$168.73 (15X) $201.03 (20X)	$475.00 commercial
Extra Lenses	$120.00 commercial				
Lamps	$8.75 commercial				
Service					

Table 7

KEUFFEL & ESSER	REMINGTON RAND	REMINGTON RAND	TAYLOR MERCHANT	WASHINGTON SCIENTIFIC	WASHINGTON SCIENTIFIC
52 9949 Micro Viewer	F440	F478	Master 400	QS Quadra Scan	1518 The Normandale
Desk 15" x 13" x 10" 19	Desk 21" x 13" x 13" 22	Desk 25" x 25" x 29" 80	Portable 6" x 3" x 8" 3	Portable 17" x 14" x 18" (open) 18	Desk 23" x 19" x 20" 36
115V --- 100 hours	115V Blower ---	115V Blower ---	115V Blower ---	115V/220V, DC, spec. Convection 200 hours	115V Blower 200 hours
6.5 and 15 No No	15 No No	14.75 No No	Variable by projection No No	6.5, 15, 20 No No	12.5 No No
10" x 8" Blue Rear projection No	10½" x 12" Gray Rear projection Yes	18" x 24" Blue Rear projection	Projected, image size variable --- --- ---	10" x 11" Green, blue, gray Rear projection yes	15" x 18" Green Rear projection Yes
Aperture card Open throat Manual	Aperture card Glass flats Removable Manual open Manual, joystick	Aperture card, 35mm roll film microfiche Glass flats Floating Manual	Aperture card Open throat	Aperture card Glass flats Removable, Manual open Joystick, manual	Aperture card, tab size microfiche Glass flats Removable, Manual open Manual
On-off, focus, joystick, image scan All front	On-off, focus, film scan All front	On-off, focus, film transport, lateral scan Front & side	On-off, focus	On-off, focus, film movement	On-off, focus, brightness, film movement All front
90 days	1 year	1 year	90 days	180 days	180 days
Local offices	Local offices	Local offices	Return to factory	Dealers	
			Projects 35mm slides	Voltage, battery options	
$240.00 commercial $1.75 commercial	$208.00 commercial	$750.00 commercial	$79.50 commercial $2.75 commercial	$289.50 commercial $2.25 commercial	

Table 7 (Continued)

APERTURE CARD READER PRINTERS

MANUFACTURER/ DISTRIBUTOR	ADVANCED TECHNOLOGY CORP.	DASA	ITEK	ITEK	3M	3M
MODEL						
Number }	ATC M-35	800 SB	1824 model F	RS	200 model 29CA	200R model 29CR
Name						
PHYSICAL						
Type	Desk	Stand	Stand	Stand	Desk	Desk
Dimensions (HWD) }		34"x33"x33"	51"x46"x36"	51"x69"x37"	33"x32"x36"	33"x32"x36"
Weight (LBS)	185	225	350	480	315	315
ELECTRICAL						
Power (AC)	115V	115V	115V	115V	115V or 220V	115V or 220V
Cooling	Blower	Blower	Blower	Blower	Blower	Blower
Rated Lamp Life	500 hours	25 hours	25 hours	50 hours	---	---
OPTICAL						
Magnifications Available }	15	13.5	14.7, 16, 17, 18	14.5	14.5, 15, 12	14.5, 15, 12
Lens Changeable	No	No	No		No	No
Image Rotation	No	No	No		No	No
SCREEN						
Size (H x W)	18" x 24"	17" x 23"	18" x 24"	18" x 24"	18" x 24"	18" x 24"
Color	Black daylight	Gray	Gray	Gray	Gray	Gray
Type	Rear projection	Rear projection	Rear projection	Rear projection	Rear projection	Rear projection
FILM CARRIER						
Card Sizes Accepted }	Standard aperture card	Aperture card, 35mm roll film, 70mm roll film,	Aperture card, all microfiche, 35mm rolls	Aperture card, 35mm roll	Aperture card, microfiche up to 5" x 8"	Aperture card, fiche up to 5" x 8", rolls 16mm & 35mm
Holder	Glass flats	Glass flats	Glass flats	Glass flats	Glass flats	Glass flats
Glass Flats }	Removable, manual open	Manual open	Removable, automatic open	Automatic open	Manual open	Manual open
Transport	Manual	Manual	Manual	Manual	Manual	Manual
CONTROLS						
Type }	On-off, focus, expose, print	On-off, focus, film movement, expose, print	On-off, focus, film movement, brightness, print	On-off, focus, expose, print, multiple print	On-off, focus, film movement, expose, print, sheet size	On-off, focus, film movement, expose, print, sheet size
Location	All front	All front	All front	All front	All front	All front

Table 8

MANUFACTURER/ DISTRIBUTOR	ADVANCED TECHNOLOGY CORP.	DASA	ITEK	ITEK	3M	3M
IMAGING SYSTEM						
Process	Electrofax	Silver stabilize	Silver stabilize	Itek RS	Electrochemical	Electrochemical
Prints	Neg to positive	Neg to positive	Neg to positive	Neg to positive	Neg to positive	Neg to positive
Warm Up Time	None	None	None	2 to 5 minutes	None	None
Print Cycle Time	30 seconds	35 seconds	30 seconds	15 sec to 25 sec	6 seconds	6 seconds
Print Sizes	18" x 24"	18" x 24"	18" high 8" to 24" wide	18" w x 10" to 24" h and other widths	18" x 26" (full) 18" x 13" (½ sheet)	18" x 26" full size 18" x 13" ½ size
SUPPLIES						
Paper						
Roll Fed		350' roll	220' roll	440' roll	237' or 300'	237' or 300'
Sheet Fed	200 sheets/pkg					
Cost/Print	$.11 approx.	$.20	varies w/volume	$.11 to .08	$.19 to .24	$.19 to .24
Shelf Life	over 1 year	18 months	1 year	1 year	---	---
Chemicals						
Type	Dry toner	Silver stabilize	Activator/stabl.	RS chemicals	3M activator	3M activator
Prints/Package	1000	Avg. 1500	660 sq ft/pkg	440 (18"x24")		
WARRANTY	90 days	90 days	180 days parts 30 days labor	180 days parts 30 days labor	180 days	180 days
SERVICE METHOD	Dealers	Direct	Field offices	Field offices	Agreement	Agreement
FEATURES/ ACCESSORIES		Meets mil spec for shock, etc.	Stack module (dryer)		Stand, various others	Stand, various others
FED. GOVT. PRICE						
Reader/Printer	$1858.00	$4850.00	$3382.00	$3880.00	$1574.50	$1675.00
Extra Lenses		$232.10			$142.50	$142.50
Lamps		$9.85	$4.00	$5.57		
Service	$200 per year		Hourly rates	Hourly rates	$135/year	

Table 8 (Continued)

VII. OTHER MICROFORM DISPLAY AND REFERENCE EQUIPMENT

In addition to the classes of readers and reader printers for the more commonly used microforms discussed in the earlier chapters, there are a great number of other highly useful and special equipments for reference to information stored in microform. Several examples are shown in figure 9. The equipment discussed here will include:

- Readers and reader printers for filmstrips and high-reduction microforms.
- Equipment that satisfies special requirements for reference to drawings and design documents in microform.
- Multi-input readers coupled to office copiers.
- Enlarger printers for volume printout from various microforms.
- Microform information storage and retrieval equipment, both free-standing and computer-linked.
- Automated and semi-automated microform files with remote display and output.

Guidance on equipment selection in these special classes of equipment cannot be given since the decision must be based more on the overall system requirements rather than the comparative features of individual pieces of equipment. In many cases, the basis for the decision is associated with the conversion of the documentation to a given microform for use in the total system. In other cases, the decision is based more on the ability of the equipment to provide a given volume or type of output than on any other consideration. Accordingly, the hardware available in each class will be described only in sufficient detail to inform the reader of the various capabilities available. The user is therefore urged to consider these capabilities in terms of the requirements in the total information processing system and discuss details of cost and capabilities of specific configurations with the supplier.

Reference Equipment for Other Microforms

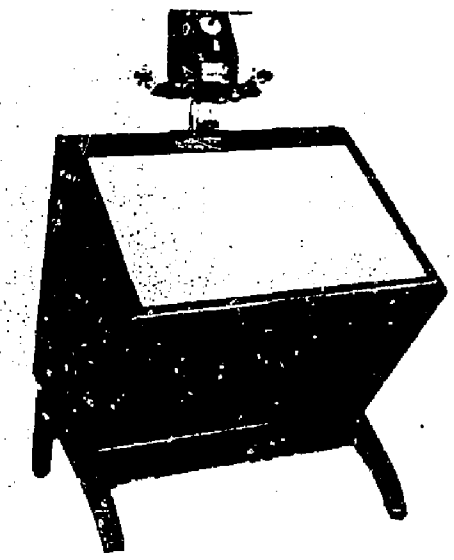
Strip Microform. One method of unitization for reference involves the placement of relatively short strips of 16-mm. film in plastic holders that serve both to store the film and transport it into the reader. This unitized microform has been found to be useful for looking up account numbers, account status, catalog items, and other directory-type reference operations. An example is the Recordak Microstrip Reader, Model PGR, which uses filmstrips up to 12 inches long that are stored in sticklike holders. Various system accessories are available, including a special holder that can hold 10 filmstrips.

High-Reduction Microforms. Higher reductions in the range 50X to 100X are currently under development for micropublishing programs. Little definitive information has thus far been released about the new services or the equipment in this range. However, anyone considering a new microfilm system, especially for micropublishing, may find it desirable to explore the developments in this area.

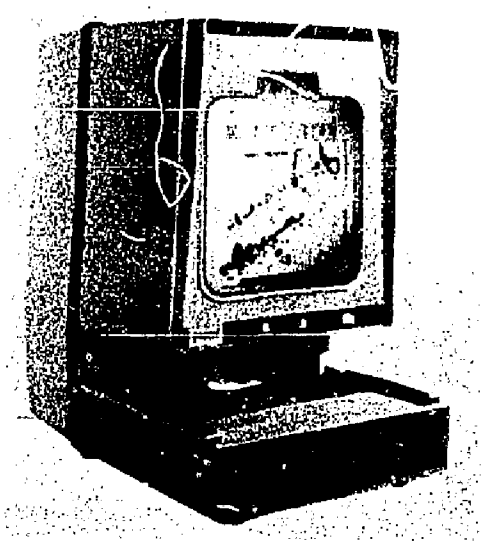
Using controlled two-step microreproduction techniques, reductions greater than 100X are being used for micropublication and controlled high-access files. These are commonly referred to as superminiaturized ultrafilm, and ultrafiche systems. Two organizations are now offering services and reference equipment for high-reduction microforms, as follows:

OTHER MICROFILM DISPLAY AND REFERENCE EQUIPMENT

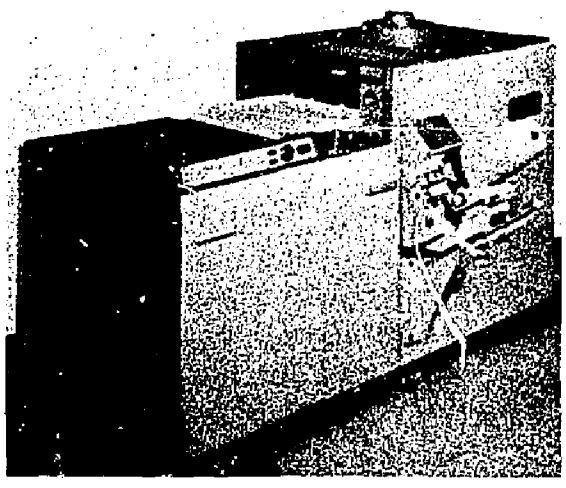
The Dennison-Readex Enlarger Printer



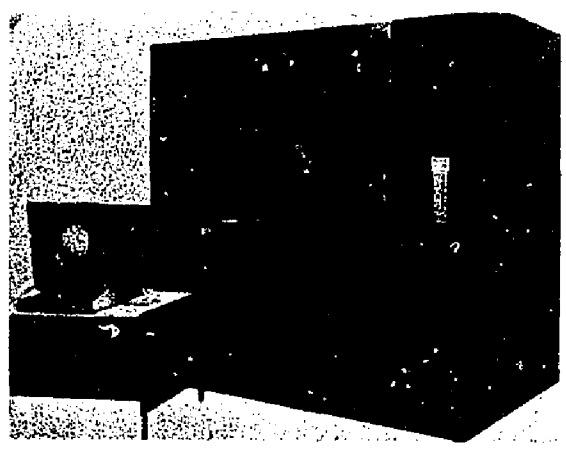
The Pamtek 900 Reader



PCMI 455-2 Reader
The National Cash Register Company



Bruning 1200 Enlarger Printer



The Sanders-Diebold SD-500
Automatic Microimage Storage,
Retrieval and Transmission System

Figure 9

PCMI System

The National Cash Register Co. uses a photochromic film for the preparation of a PCMI (Photo-Chromic Micro-Image) master by first filming the documents on 35-mm. film and then making a reduced film copy of these images. This results in a final reduction of 150X. This master is then used to prepare distribution transparencies containing up to 3,000 letter-size images on a 4- x 6-inch ultrafiche.

The NCR 455-2 PCMI Reader uses an X-Y positioned film holder and 150X optical system to provide reference to the images on an 11- x 11-inch screen. A reader printer, the NCR Model 455-21, using an electrostatic process for paper copies, is also available.

MINDEX System

Microform Data Systems, Inc., uses high resolution photographic materials to produce 35-mm. ultrafilm masters by second step reduction from 35-mm. images of the original documents. Working at reductions of up to 210 diameters, ultrastrip distribution copies contain up to 2,000 letter-size pages on a 6-inch by 35-mm. filmstrip.

Currently three readers are offered. The Mindex/330 uses manual strip insertion, field selection, and X-Y positioning to provide reference at enlargements up to 190X to the ultramicroimages. The model 350 uses keyboard input and magnifications up to 230X for automated image selection and display. The Mindex/370 provides strip, field, and image selection via keyboard from a cartridge of 10 ultrastrips. For the latter two units integrated video display units are available for retrieval of index information from the computer.

Special Equipment for Engineering Reference

Expanded use of microfilm for engineering drawings has resulted in the development of special equipment for more efficient or useful reference.

The Graphic Comparator, made by the DASA Corp., permits the simultaneous examination of microimages representing successive levels of revision of an architectural plan or hardware design, with the changes clearly delineated. Using a unique dual projection system (one with fixed blowback and alinement, the other with compensating alinement and blowback), the unit projects the superimposed images from two similar aperture cards on an 18- x 24-inch screen. Lines common to both images appear white on the screen, while lines that represent additions or deletions are shown in green and red, respectively.

In some programs, and particularly in the architectural and construction fields, there is a need to enlarge microimages of design drawings to full size for "take off" cost calculations or near full size for other reference purposes. Two lines of equipment are available for this purpose, as follows:

A series of large screen (24 x 36 inches) readers and reader enlargers are offered by Pantek Manufacturing, Inc. The units handle all engineering microfilm formats and project the image on a screen that can be oriented to the user either at desk height or at drafting table height. The Model 900 provides a 22X blowback; and the Model 902, interchangeable blowbacks of 22X and 38X. Other magnifications from 16X to 40X are available. The Models 900-P and 902-P provide for the exposure of a photographic paper which is processed in an accessory stabilization processor.

The Charles Bruning Co. offers a unit called the Multifocus. Continuously variable enlargement from 10 to 40X makes it possible to view all of the image on most engineering microforms on the desk height, 15- x 21-inch screen. Blowback variability also makes it possible to view B size drawings or 14- x 20-inch sections of larger drawings at full size from most engineering microforms. Provision is made for the exposure of photographic enlarging papers to be processed in stabilization processors.

Reader-Copier Combinations

For many libraries and information centers, the capabilities offered by combination reader-enlarger-copiers may warrant consideration. At present, two such equipment combinations designed for volume copying are available:

The Readex Microprint Corp. offers the Dennison-Readex Enlarger Printer. This unit couples a Readex Universal Reader capable of displaying images from both opaque and transparent unitized microforms with the Dennison Electrostatic Copier. Paper copies at 15X enlargement provide either 8½- x 11- or 8½- x 14-inch prints. The combination is normally used to prepare positive enlarged copies of positive microimages; however, positive enlargements can be made from negative microforms by changing to reversal toner and intensifiers for the electrostatic process. The installation includes a microform reference table adjacent to the copier for the reader's use.

The Xerox Microprinter combines a reader, designed especially for this purpose, with a 914 copier. The reader has adapters for roll film, microfiche, and aperture cards. Magnifications of 12, 16, 20, or 24X are available for the preparation of 8½- x 11-inch enlarged paper copies. On the positive mode model which makes positive prints from positive microfilm, the unit can also be used as a standard office copier by sliding the reader to the rear and off the document copy table.

High-Volume Enlarger Printers

Units are available for the preparation of enlarged hard copy in quantity from microfiche, roll film, and aperture cards. Depending on the microform and output speed, purchase cost ranges from about $7,000 to $180,000. Most of the equipment in this class is also available on lease or a rental basis.

Microfiche. The NCR Microfiche Enlarger Printer is available in two models: Model 458-401 for 4- x 6-inch microfiche, and the 458-402 for punched card sized microfiche. The units use a programed step and repeat film transport and exposure cycle and a 16X enlarging system to provide 8½- x 11-inch copies at a speed of 10-12 copies per minute. A dry developed, roll-fed, silver enlarging paper is used.

Roll Film. For the continuous high-speed enlargement of microimages from 16- and 35-mm. roll film, a series of four models of the Copyflo 11 are available from the Xerox Corp. Fifteen magnifications ranging from 7X to 24X provide enlargement up to 11-inch-wide images on continuous, roll-fed, 12-inch paper. Model 1-20, 1C-20, and 3 all operate at an output of 20 feet a minute, the model 1-40 at 40 feet a minute. Output from all models except the 1C-20 is rolled print output. The 1C-20 incorporates a mark-sensing automatic cutter and receiving tray on the output. In addition to making enlarged copy from microfilm, the model 3 incorporates a belt-fed throat and optical system for 1 to 1 and 2 to 1 reduction copying of documents manually fed into the unit.

Aperture Cards. While the enlarger printers described below have been primarily designed for enlargement of the images in aperture cards, some of them, as will be noted, offer enlargement and adaptability to roll film. Available units include:

1. The Bruning 1200 enlarger printer uses a direct electrostatic process and a combination roll paper feed to produce prints in up to six sizes from 8½ x 11 to 18 x 24 inches. Print output is four prints per minute. Aperture cards are manually inserted in an optical system that provides variable enlargement from 14X to 16X for printing and a reduced image display on a locator screen. From 1 to 20 prints can be programed. A roll film adapter is available, and flexibility is increased through the use of lenses that provide magnification ranges of 7¾X to 8⅞X and 11¾X to 13¼X.

   Using the proper toner, either negative to positive or positive to positive, dry

electrostatic prints can be made. The 1200 will also produce offset masters and diazo intermediates when the appropriate paper is used.

2. The 3M 333 enlarger printer uses 3M Co.'s dry silver paper to produce enlarged prints from aperture cards in manual, semiautomatic, or automatic mode. Cards may be fed manually or automatically from the card feeder which will hold up to 200 aperture cards. The unit can be programed to produce from one to 25 prints of each card. Under full automated operation, prints are produced at rates up to 15 per minute.

   Standard enlargement is 14.5X, but 15X and 16X lenses are available. From an 18-inch stock roll, print length can be controlled from 10 to 25 inches in 2½-inch increments by adjusting the mask on the small verification screen on the card transport.

3. The Xerox 1824 uses the transfer electrostatic process and hand-fed cut sheets to produce 8½- x 11-, 11- x 17-, and to 18- x 24-inch prints. Magnification is fixed at 14.5X. A manual roll film transport is provided along with a small viewing screen for positioning images to be printed from rolls. Depending on operator dexterity and whether single or multiple prints are being made, output is up to four prints per minute. By feeding the appropriate paper stock, offset masters or translucent intermediates may also be made.

4. The Xerox Copyflo 600 is an automated enlarger printer for aperture cards. Cards can be fed manually or automatically from a card feeder with a capacity for 200 cards. The unit can be programed for from 1 to 99 prints. Paper feed is automatic under operator control from feeders for sizes 8½ x 11, 11 x 17, and 17 x 22 (or 18 x 24) inches.

   Magnifications of 12X, 14.5X, 15X, and 16X are available. Output is up to 600 prints per hour or 10 per minute. Using an override to slipfeed the appropriate stock, the unit will also produce offset masters or translucent prints.

5. The Xerox Copyflo 24C is a roll-fed, continuous-enlarger printer designed for automatic preparation of paper copies from aperture cards (up to 400 prints per card) or roll film. Enlargement may be either 15X or 20X. Roll stock from 11 to 24 inches wide may be used as input. Output is 20 lineal feet of prints per minute (or about six 24- x 36-inch prints per minute) which are cut to size by an automatic cutter. The unit can be set up to provide positive printout from either positive or negative images, but not intermixed. Offset master and translucent paper stock may be used to produce prints as well.

Microform Information Storage and Retrieval Systems

While several of the more automated readers and reader printers described earlier in this handbook may be incorporated into information storage and retrieval (ISR) stations or centers, there are several "closed" systems in which the ISR equipment hardware is matched to the file organization or indexing used to control the document collection at the time of conversion to the microform used. As most widely used, two of these systems, Kodak's MIRACODE and Image Systems' CARD, use varied levels of file organization to produce free-standing ISR stations. The third, AIL Information System's FILESEARCH IV, uses a random file organization (which can be structured as needed) for the document collection in microform.

The more automated Mindex units from Microform Data Systems, described in the section on high reduction microforms, can also be used in ISR installations of this type.

MIRACODE

This system uses photo-optically binary coded 16-mm. film in magazines to build

the ISR file. The file may be updated daily or at any required frequency by splicing strips of new film into the film magazines in the file. Before a document is recorded its conceptual identity or file identity is recorded on the film in optical binary code either by the operator at the camera, by using a punched card and a keypunch coupled to the code camera, or using COM to place the code on the film.

The MIRACODE retrieval station consists of a file of 16-mm. film magazines, a Lodestar reader printer containing the code sensing and logic electronics required to make a search and a keyboard for the input of the search codes.

CARD

The CARD unit is a desk top, automated file and display device for up to 73,500 document pages filed on microfiche. Keyboards matched to standard 4- x 6-inch microfiche formats are available, and keyboards matched to various file organizations have been designed.

Within the unit, up to 750 microfiche are filed in a horizontal rotary wheel. Each microfiche is uniquely identified in binary code in a metal strip affixed to the edge of the fiche in the microfilm conversion process. Entry of the required fiche identity into the keyboard actuates the mechanism which selects the desired microfiche and places it in the optical system of the unit. In many applications, an index page is first displayed. From it, the operator selects and keys the X and Y grid location of the desired image.

FILESEARCH IV

The Filesearch IV retrieval unit consists of an input keyboard, a small computer to provide search logic, a film transport for 1,000-foot rolls of perforated 35-mm. film, and several output modes. At the operator's option, output can be either a screen display, a paper copy, or a film-to-film copy of pertinent images. The 1,000-foot roll of film contains 32,000 frames; each frame will accommodate a document up to 8½ x 14 inches and up to 56 alphanumeric characters of index information in optical binary form. Using the film-to-film output, documents can be copied from the random total file to provide a roll film file of documents on a particular subject or combination of index codes.

The system includes a recording unit or camera that records both the document and the index information simultaneously. The document is placed on the copyboard of the camera, and the index codes are read from punched cards. The recorder produces 100-foot rolls of film that, when processed, are spliced onto the larger rolls for use in the retrieval unit.

These systems indicate the limitless ways that automated microfilm files can be used for reference to voluminous collections which need be updated at no more than daily frequency, or where these mass memories can be coupled with time-sharing computer systems for "real time" access to both historic or status and updating information.

Central Files With Remote Output

Semiautomated and automated files with remote output display for unitized microforms are available in two systems lines; one from Sanders Associates, Inc., and Diebold, Inc.; the other from the Mosler Co. Both lines provide a building block approach to the system configuration, resulting in:

Remote TV display of information stored in a manually accessed or operated central file.

An automated central file with hard copy output or film-to-film output; or remote-controlled, remote TV display with optional hard copy output at the remote terminal.

A computer-controlled system in which the computer is used to provide index access to and file control of the automated mass

memory file in microform, the system having all the output flexibility outlined above.

SANDERS-DIEBOLD Systems

The basic system is the SD-550 Information Retrieval System. It consists of a console TV image transmitter (controlled by the file clerk or by a remote terminal) and one or several remote display terminals. Typically, the transmitter is installed adjacent to a Diebold power file in which are stored the various unitized microforms. The transmitter accepts manual input of aperture cards, microfiche or jackets up to 6 x 8 inches (or, on modification, 8-, 16-, and 35-mm. filmstrips) at image reductions from 12/1 to 24/1 and provides magnification to full size and a 5/1 power zoom for enlargement of detail. The system is distributed by Diebold, Inc.

The SD-500 Automatic Microimage Storage, Retrieval and Transmission System is distributed by Sanders Associates to the Federal Government and to others by Diebold, Inc. The heart of this system is a closed file containing automatic retrieval, transmission, and scanning capabilities. Unitized microforms of any type, mounted in plastic holders are stored in the file in dedicated positions. The standard file has a capacity of 49,000 microforms; an optional larger file stores 68,600. The transmitter provides full blowback of documents reduced from 12 to 24 diameters and a 5 to 1 power zoom. File operations are under control of the SD-500 remote display terminals. Optional building block features include those noted in the introduction to this section.

MOSLER Systems

The Mosler 20/20 consists of a TV transmitter console for microfilm aperture cards and one to six remote display terminals. On telephone request, the file clerk selects the desired aperture card, places it in the transmitter, and switches transmission to the requestor's display terminal. At the terminal, the requestor controls image scan and enlargement via zoom lens up to 250X (or about eight times original size for a drawing reduced 30X). Remote printers for 8½- x 11-inch prints of the display are available.

The basic building block of the Mosler 410 series of information systems is an automated file for 200,000 items, either punched cards, aperture cards, or punched card size microfiche. Items are edge-notched with a file identity and filed randomly, 100 items to a cartridge. One thousand cartridges are filed in each of two banks served by a common cartridge retrieval mechanism, which delivers the cartridge to the card retrieval station in the control console. The basic 410/05 can be used to retrieve information which would then be reproduced by operators to satisfy requests. Using a human link it could be tied into the Mosler 20/20 transmission system. Again, in building block fashion, automated film-to-film output, remote display and printout, computer control and the other capabilities outlined in the introduction can be added as needed.

APPENDIX

EQUIPMENT MANUFACTURERS AND DISTRIBUTORS

Advanced Technology Corp.
P.O. Box 246
Chambersburg, Pa. 17201

Atlantic Microfilm Corp.
700 South Main Street
Spring Valley, N. Y. 10977

Bell and Howell Co.
Business Equipment Group
6800 McCormick Road
Chicago, Ill. 60645

Charles Bruning Co.
1800 West Central Road
Mount Prospect, Ill. 60056

DASA Corp.
15 Stevens Street
Andover, Mass. 01810

Dennison Manufacturing Co.
300 Howard Street
Framingham, Mass. 01701

Eugene Dietzgen Co., Inc.
2425 N. Sheffield Avenue
Chicago, Ill. 60614

Dukane Corp.
103 North 11th Avenue
St. Charles, Ill. 60174

Eastman Kodak Co.
Business Systems Markets Div.
343 State Street
Rochester, N. Y. 14650

The Ednalite Corp.
200 North Water Street
Peekskill, N. Y. 10566

B. K. Elliott Co.
P.O. Box 3240
Pittsburgh, Pa. 15230

GAF—Reprographic Products
140 West 51st St.
New York, N. Y. 10020

Image Systems, Inc.
11244 Playa Court
Culver City, Calif. 90230

Information Handling Services, Inc.
Denver Technological Center
Englewood, Colo. 80110

Itek Business Products
1001 Jefferson Road
Rochester, N. Y. 14603

Keuffel & Esser Co.
30 Whippany Rd.
Morristown, N. J. 07960

Micro Design, Inc.
235 S. Johnson St.
Hartford, Wis. 53027

Micro Image Corp.
10469 Roselle St.
San Diego, Calif. 92121

Microform Data Systems, Inc.
Suite 1507—Palo Alto Office Center
Palo Alto, Calif. 94301

Mosler Co.
1561 Grand Blvd.
Hamilton, Ohio 45012

NCR—Industrial Products Div.
3100 Valleywood Drive
Dayton, Ohio 45429

Pamtek Manufacturing Co.
4221 Hollis St.
Oakland, Calif. 94608

Frederick Post Co.
P.O. Box 803
Chicago, Ill. 60690

Readex Microprint Corp.
5 Union Square
New York, N. Y. 10003

Realist, Inc.
N93 W16288 Megal Drive
Menomonee Falls, Wis. 53051

Remington Rand Office Systems
P.O. Box 171
Marietta, Ohio 45750

Sanders Associates, Inc.
95 Canal St.
Nashua, N. H. 03060

Stromberg DatagraphiX, Inc.
P.O. Box 2449
San Diego, Calif. 92112

The Taylor-Merchant Corp.
25 West 45th St.
New York, N. Y. 10036

3M Company
Microfilm Products Div.
3M Center—220-10
St. Paul, Minn. 55101

University Microfilms/Xerox
300 North Zeeb Rd.
Ann Arbor, Mich. 48106

Washington Scientific Industries, Inc.
13111 Wayzata Blvd.
Minnetonka, Minn. 55343

Xerox Corp.
Xerox Square
Rochester, N. Y. 14603

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